Water Chemistry of 145 New Brunswick and Nova Scotia Headwater Lakes

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WATER CHEMISTRY OF 145 NEW BRUNSWICK AND NOVA SCOTIA HEADWATER LAKES

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ABSTRACT

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The water chemistry data for 76 Nova Scotia and 69 New Brunswick headwater lakes are analyzed. Lakes in the two provinces had similar surface area distributions, but more deep lakes were sampled in New Brunswick. The mean ratios of catchment area:lake surface area are near 6 for both provinces. Nova Scotia had more acidic lakes (64% < pH 5.8) than did New Brunswick (16%), and more lakes with >10 mg/L DOC. New Brunswick lakes tended to have higher excess SO_4^{2-} concentrations. The method used to estimate SO_4^{2-} concentrations in this study (turbidimetry) yielded overestimates by about 15 µeq/L. New Brunswick lakes tended to be more highly buffered, but appeared to have lost more alkalinity due to acidification. Dissolved organic carbon (used as an indication of amounts of organic acids present) did not appear to influence the acidification process (as indicated by Henricksen's empirical pH-Ca^{2+} relationship) in lakes with excess Ca^{2+} concentrations greater than 40 µeq/L. In lakes wih Ca^{2+} levels less than 40 µeq/L, those with greater amounts of DOC were more acidic. Most of the variability in total dissolved Al and Fe concentrations among lakes could be accounted for by lake pH and lake DOC concentrations. Lake pH was less important in influencing total dissolved Fe than Al.

RÉSUMÉ

Peterson, R. H., D. Townsend, and D. J. Martin-Robichaud. 1986. Water chemistry of 145 New Brunswick and Nova Scotia headwater lakes. Can. Tech. Rep. Fish. Aquat. Sci. 1493: iii + 36 p.

On a analysé les données sur la composition chemique de l'eau de 76 et 69 lacs d'amont de la Nouvelle-Écosse et du Nouveau-Brunswick respectivement. La superficie totale des lacs échantillonnés est relativement la même pour les deux provinces mais le Nouveau-Brunswick comptait plus de lacs profonds. Le rapport moyen entre la surface de bassin-versant et la superficie des lacs est d'environ 6 pour les deux provinces. La Nouvelle-Écosse compte plus de lacs acides (64 % ont un pH inférieur à 5,8) que le Nouveau-Brunswick (16 %) et davantage de lacs contenant plus de 10 mg COD par litre d'eau. En général, les lacs du Nouveau-Brunswick avaient de plus fortes concentrations excédentaires de SO_4^{2-}. La méthode utilisée dans la présente étude (turbidimétrie) pour estimer les concentrations de SO_4^{2-} a donné des surestimations d'environ 15 µE par litre d'eau. Le pH des lacs du Nouveau-Brunswick semble être plus constant mais leur alcalinité semble avoir baissé en raison de l'acidification. Dans les lacs ayant des concentrations excédentaires de Ca^{2+} supérieures à 40 µE/l, le carbone organique dissous (utilisé pour indiquer les quantités d'acides organiques présentes) n'a pas semblé influencer le processus d'acidification (comme le montre le rapport empirique entre le pH et le Ca^{2+} établi par Henricksen). Quant aux lacs dont les niveaux de Ca^{2+} étaient inférieurs à 40 µE par litre d'eau, l'acidité augmentait en proportion de la quantité de COD. En général, la variabilité entre les divers lacs, au niveau des concentrations globales de Al et de Fe dissous, pourrait s'expliquer par le pH et les concentrations de COD dans les lacs. Le pH des lacs a eu une influence moins importante sur les concentrations globales de Fe que sur les concentrations de Al.

INTRODUCTION

Acidic precipitation was perceived as a potential problem to Maritime freshwater systems in the Maritime Provinces in the mid 1970's as a result of demonstrated problems in Scandinavia (Leivestad and Muniz 1976), New England (Schofield 1977) and Ontario (Beamish 1974). Studies of Maritime freshwater systems in the late 1970's established the extreme sensitivity of many Nova Scotian lakes and rivers (Farmer et al.1980; Kerekes 1980; Watt et al. 1979). Lakes in sensitive areas of New Brunswick have also been delineated (Peterson 1980; Peterson and Martin-Robichaud 1984; Spavold-Tims and Hawkins 1985; Clair et al. 1985). Whether or not any Maritime waters have become more acid within the last 30-40 yr, due to long-range transport, has been somewhat controversial as the contributions of organic acidity have been uncertain (e.g. Wiltshire and Machell 1981; Underwood et al. 1981). Also, historical pH records are limited, and possibly of uncertain value, due to methodological differences. More recently, there seems to be a consensus that, although organic acids do affect pH, a discernible decrease in lake and stream pH due to atmospheric loadings of strong acids - mainly sulfuric and nitric - has occurred (e.g. Kerekes et al. 1984b).

One hundred and forty-five lakes were surveyed in New Brunswick and Nova Scotia in 1981-82 as part of a national inventory funded by the Department of Fisheries and Oceans. The objective of the survey was to obtain sufficient information on the status of fish species inhabiting Maritime lakes of varying water chemistries, so that estimates of the probable impact of acid precipitation on these fish communities could be made. Similar surveys were performed in Ontario, Quebec, Newfoundland and Labrador with reports available describing the Quebec and Newfoundland surveys (Scruton 1983; Langlois et al. 1985). Kelso et al. (1986) have analyzed the data for differences among the various regions involved.

In this report, we present the physico-chemical data obtained for the lakes surveyed. These lakes were not selected randomly. Lakes situated on granitic or metamorphic (southwestern N.S.) bedrock materials, known to provide low buffering capacity to waters draining them, were catalogued. Lake and catchment areas were measured, and catchment:lake areas calculated. Lakes were selected from this catalogue, based upon low catchment: lake area ratios and relative lack of human disturbance. Most, but not all, of the surveyed lakes are headwater, or first order lakes, which will influence the morphometry of the lakes and the fish species inhabiting them. All parts of New Brunswick and Nova Scotia were not surveyed uniformly, because much of New Brunswick and some of Nova Scotia is underlain by sedimentary formations which provide ample buffering to their surface waters. Some clustering was also due to cost limitations, as helicopter rental was a limiting economic factor. Separate reports on the fish and invertebrate biota surveyed in these lakes are being prepared.

METHODS

In July and August of 1981, 112 lakes were surveyed (56 in both New Brunswick and Nova Scotia). An additional 33 lakes were sampled in July and August of 1982 (13 in N.B. and 20 in N.S.). All 145 lakes sampled are shown in Fig. 1 (N.B.) and 2 (N.S.). Criteria for selection, other than those discussed in the Introduction, were the presence of visible rock formations, and little or no emergent vegetation. Descriptions and map coordinates of each lake are provided in Appendix 1.

Water samples and measurements of physical parameters were collected near the center of each lake at approximately the same location each time. Depth, secchi disc readings and the water temperature profile were determined. Temperatures were recorded with a remote tele-thermometer.

A 5-m length of polyethylene tube (1.90 cm ID and 2.54 cm OD) was lowered to a maximum depth of 5 m, or 1 m above the bottom if the depth was less than 5 m. The tube was prerinsed with lake water. If a thermocline existed at less than 5 m, the tube was lowered just to the bottom of the metalimnion. When the appropriate depth was reached, the upper end was capped with a rubber stopper, the tube retrieved and the water sample collected into a thrice-rinsed 2-L polyethylene bottle. The tube sampler was capped when not in use, and people using the sampler wore rubber gloves rinsed with lake water. A final volume of 1.5 L was sampled. Water samples were stored in darkness on ice until arriving at the laboratory where they were kept refrigerated at 10°C until further analyses. For analysis, the sample temperature was raised to 20°C.

To ensure adequate conductivity, a 100-mL subsample of water had 1 mL of 1M KCl added before field pH measurements were determined with a Can Lab portable pH meter (Model H5503-1) which was appropriately standardized.

Gran alkalinity titrations were conducted on the water samples within 24 h. The electrode of a standardized pH meter was immersed in a continuously stirred 100-mL water sample. After stabilizing, an initial pH was determined. If this pH was less than 5.0, 1 mL of 1M KCl was added to increase the conductivity of the sample and facilitate stabilization of the recordings. Replicate samples always had KCl added. The samples were titrated with 0.0100 N HCl added in aliquots (0.1 mL) delivered with an Eppendorf pipette. At least 20 meter readings between pH 5.50 and 3.50 were obtained during the course of each titration but only pH values less than the equivalence point (approximately pH 4.7) were used in the Gran function determination of alkalinity. Larger aliquots (0.2 mL) were used once the equivalence point was reached since the rate of change in pH decreased substantially. The methodology used is described in manuals prepared by the Ontario Ministry of the Environment (Anon. 1979a) and the Ontario Ministry of Natural Resources (Anon. 1980).

The concentrations of Na^+, K^+, Cl^-, Ca^{++}, and SO_4^{2-} ions in the water sampler were determined using the techniques described in the Inland Waters Directorate Analytical Methods Manual (Anon. 1979b).

One series of samples was taken in triplicate from six lakes for quality control considerations. One set was analyzed by the Water Quality Branch, Environment Canada (Moncton, N.B.), the other two sets by the original analyst (K-F Laboratories, Fredericton, N.B.) - one within a day after the samples were returned to the laboratory and the other at the same time as those being analyzed in Moncton. Analytical results of the two laboratories

were consistent. The analytical laboratory was also a participant in the Department of Environment inter-laboratory calibration program.

In 1982 the water sampled with the tube was divided into three 250-mL containers. The sample to be analyzed for iron and manganese was preserved with approximately 2 mL of concentrated Aristar® grade HNO_3/L. In the laboratory, the samples for dissolved organic carbon and aluminum were filtered through 0.45-μ filter paper and then preserved with 1 mL of concentrated HCl/L and 2 mL of concentrated HNO_3/L for dissolved organic carbon (DOC) and aluminum analysis, respectively.

A Beckman (Model 915A) organic carbon analyzer with infrared combustion was used to measure the DOC content of the water samples. Aluminum, iron and manganese concentrations were measured using atomic absorption spectrophotometry.

RESULTS AND DISCUSSION

GEOGRAPHIC DISTRIBUTIONS OF LAKES SAMPLED

The majority of the lakes sampled were clustered either in southwestern New Brunswick or southwestern Nova Scotia (Fig. 1, 2). The former lakes are situated primarily on strata of Devonian granite, with a few extending into some of the sedimentary formations. The Chamcook group (Nos. 25-29) are situated partly on granitic and partly on Devonian gabbro. A cluster of three lakes (Nos. 1-3) are in Precambrian formations of mainly granite. Similarly, the southwestern Nova Scotian cluster of lakes lie on Devonian granite to grano-diorite and diorite. Some of these lakes extend out into the Meguma sedimentary and metamorphic formations. The lakes sampled in northern N.B. lie either on Devonian granite (60, 62, 63, Fig. 1) or Ordovician and Silurian sedimentary formations. One lake (No. 64, McLean) was in the extensive Pennsylvanian sandstone which covers much of central and northeastern N.B. The five lakes to the east of Saint John on the Fundy coast (65-69) are situated primarily on Precambrian rocks of mixed origin. The bedrock geology of Cape Breton is so complex that the bedrock characteristics of the catchment areas of those lakes sampled is uncertain.

LAKE TEMPERATURES

Lake surface temperatures varied from 18-25°C. Surface temperatures in northern New Brunswick and Cape Breton tended to be cooler than those sampled elsewhere - usually not exceeding 20°C. Those in southern New Brunswick and Nova Scotia were almost always in excess of 20°C. Little stratification occurred in lakes shallower than 6 m, while those in excess of 8 m exhibited stratification with bottom temperatures of 10-13°C.

LAKE MORPHOMETRICS AND CATCHMENT CHARACTERISTICS

More lakes in the New Brunswick subset had depths exceeding 5 m than in the Nova Scotia subset (Fig. 3). Lakes in southwestern Nova Scotia, in particular, were uniformly shallower than 5 m. This part of Nova Scotia has a low topographical profile, possibly resulting in more shallow lakes than southern New Brunswick and Cape Breton, which are more hilly.

Areas of lakes sampled are similar for the two provinces (Fig. 4), with most lakes being of 90 ha or less and a scatter of larger lakes. Catchment area was linearly related to lake area with a slope of about 0.16 (lake area = 14.1 + 0.14 catchment area, r^2 = 0.78 for N.S. lakes; lake area = -5.4 + 0.18 catchment area for N.B. lakes, r^2 = 0.47), indicating an average catchment area:lake area ratio near 6 - in agreement with the modal ratios shown in Fig. 5. There was no significant correlation between lake depth and lake area for data sets from either province. This lack of correlation is probably a reflection of the narrow range of lake sizes sampled.

SEASALT INFLUENCE

The chemistry of surface water in New Brunswick, and particularly in Nova Scotia, is greatly influenced by ions derived from sea spray which has been injected into the weather system (see also Underwood 1981; Peterson 1980). New Brunswick lakes are relatively more protected from seasalt influence than are Nova Scotia lakes (Fig. 6). For example, lakes nearly 100 km inland in southwestern Nova Scotia contain more chloride (assumed to be derived entirely from sea salt) than do New Brunswick lakes only a few kilometers from the Fundy coast. It is probable that no Nova Scotian lakes contain less than 50 μeq/L of Cl^-, while those of central and northern New Brunswick may have only 10-20 μeq/L of Cl^-. These facts are no doubt related to the more elongated geometry of Nova Scotia and to its being essentially surrounded by salt water, so that storms approaching from any direction will be heavily laden with sea salt.

In order to consider other aspects of lake chemistry, it is essential to factor out the seasalt influence. To do this, we have made the usual assumption that lake Cl^- is derived entirely from sea salt. Other ions are reduced according to the equivalent ratios of these ions to Cl^- in ocean water. Sodium, K^+, Mg^{2+}, and SO_4^{2-} concentrations in Maritime lakes all include a considerable seasalt component (App. 2).

LAKE pH

The most acidic lakes sampled were encountered in southwestern Nova Scotia (Fig. 7). A cluster of lakes, most of pH less than 4.5, occur just to the west of the Mersey River drainage. Lakes with pH levels this low may extend eastward through Kejimkujik National Park, which was not sampled. Three other lakes scattered through eastern Nova Scotia also had pH levels less than 4.5. We do not believe any of these lakes to be acid due to exposed pyrites deposits in the catchment basin, as described by Kerekes et al. (1984a) for some lakes near Halifax.

Lakes with pH levels ranging from 4.6-5.5 are in an arc from westward to northeastward around the cluster of most acidic lakes. Scattered lakes in this pH range also occur in eastern Nova Scotia and southern New Brunswick, just to the west of the Saint John drainage.

Lakes with pH levels of 5.6-6.5 predominate in northwestern Nova Scotia, along the Digby-Kentville axis, in southern New Brunswick, immediately to the east of Saint John, and in Cape Breton. Lakes sampled in the Chignecto Isthmus and in western,

central and northern New Brunswick have pH levels higher than 6.5.

According to the bicarbonate titration model of lake acidification (e.g. Henriksen 1982), lakes that have been titrated to pH near the bicarbonate end-point (ca. pH 5.5) should be unstable with respect to pH. They are easily shifted away from a pH near 5.5 by any other weak bases or acids in the system. A histogram of the pH distributions in N.B. and N.S. (Fig. 8) does indicate fewer lakes at pH 5.3-5.7 as compared to lakes slightly more or less acidic. The pattern is particularly evident when the data for the two provinces is combined.

ORGANIC MATTER

There has been much discussion regarding the influence of organic acids on lake and stream pH, particularly for the Nova Scotian watersheds (e.g. Kerekes 1984). The presence of humic substances has also been found to interfere with colorimetric (methyl thymol blue) sulfate determinations in highly colored humic waters (Kerekes et al. 1984b). A turbidimetric method for sulfate determination was used for this survey. Of the 145 lakes surveyed in this study, five were also surveyed for a different study in 1983 (Peterson and Martin-Robichaud 1984). In the 1983 study, both ion chromatographic and colorimetric sulfate determinations were performed. The turbidimetric sulfate values for the study recorded in 1981-82 on these five lakes averaged 15 µeq/L higher than did the ion chromatographic values for the 1983 samples, and were nearly identical to the 1983 colorimetric values. None of the five lakes sampled in both surveys had very high dissolved organic matter (2.5-6 mg/L), so that the difference in SO_4^{2-} determined by the two methods was not dependent on lake color. Therefore, the turbidimetric values presented in this report may be about 15 µeq/L higher than would have been measured with the ion chromatograph, and are probably similar to values that would be obtained by the colorimetric method for lakes containing <5-6 mg/L DOC.

The DOC content of the lakes surveyed varied from <2 to 19 mg/L. Lakes surveyed in southern N.B. tended to be of greater clarity than those from the remainder of N.B. or from N.S. (Fig. 9).

When the surveyed lakes are positioned on a pH-DOC grid (Fig. 10), one can see again that the southern N.B. lakes lack the highly organic lakes included in those sampled from N.S. or west-central N.B. Lakes from the latter two areas have similar ranges of DOC, but are distinguished by the lower mean pH of the southern N.S. lakes. At DOC levels greater than 9 mg/L, no pH values greater than 5.2 were obtained for N.S. lakes. Cape Breton lakes resembled those sampled from west-central N.B. with respect to pH-DOC characteristics. The pH range of clear water N.S. lakes overlaps broadly with that of southern N.B. lakes.

To assess the possible influence of organic matter on the turbidimetric SO_4^{2-} determinations made in the 1981-82 survey, excess (non-sea-salt) SO_4^{2-} was plotted against DOC for two subsets of lakes which should have had fairly uniform atmospheric SO_4^{2-} loading (southwestern N.B., and southwestern N.S. (Fig. 11)). There is no apparent influence of DOC on the SO_4^{2-} determinations for either subset of lakes. We will assume, in the absence of more refined studies on SO_4^{2-} levels in these lakes, that SO_4^{2-} determination was not influenced by the amount of organic matter present.

LAKE SULFATE CONCENTRATIONS

Lake sulfate concentrations (seasalt SO_4^{2-} substracted) were highest in the five lakes sampled in southern N.B. (to the east of Saint John) at 102.2 µeq/L (Fig. 12, 4th panel). Mean concentrations in the rest of the N.B. areas were near 80 µeq/L, while those in mainland N.S. had mean concentrations of 65-70 µeq/L. Lakes in Cape Breton had the lowest mean SO_4^{2-} concentrations at 52 µeq/L; although only six lakes were sampled. Geographical gradients in apparent sulphate deposition in Nova Scotia have been reported by Underwood et al. (1986) and Kerekes et al. (1986). Lakes near Yarmouth averaged 45 µeq/L, those in Kejimkujik Park 30 µeq/L and those in Cape Breton 17 µeq/L. Our data gives values of 49.8 µeq/L for southwestern Nova Scotia, and 37.0 µeq/L for Cape Breton - somewhat higher than reported by Kerekes et al (1986), even after subtraction of 15 µeq/L. Southwestern N.B. lakes, in addition to higher alkalinity deficits, have correspondingly higher excess sulphate levels at 60.4 µeq/L (n = 18) and 58.8 µeq/L (n = 24) for the Lepreau region. The five lakes east of Saint John averaged 81.2 µeq/L, indicating perhaps some local enrichment to the windward side of Saint John. Similarly the mean of 51.8 µeq/L for lakes lying east of Halifax may include some local influence.

POTASSIUM

Seasalt corrected K^+ was usually present at 4-8 µeq/L. New Brunswick and Cape Breton lakes had higher mean concentrations (8.1, 6.8, 7.6, 6.4 µeq/L for Cape Breton, western, north-central, and southwestern N.B., respectively) than did lakes of mainland N.S. (3.5 and 5.3 µeq/L for eastern and southwestern N.S., respectively). The five southern N.B. lakes also had less K^+ (mean of 5.3 µeq/L) than did lakes elsewhere in the province.

CALCIUM AND MAGNESIUM

Calcium and magnesium concentrations in lake water are indicators of innate buffering capacity of the system, as they are usually associated with bicarbonate. Therefore, mapping the summed excess calcium ($^*Ca^{2+}$) and magnesium ($^*Mg^{2+}$) should serve as an indicator of original lake buffering capacity. Such a mapping (Fig. 13) indicates that a lake cluster in southwestern N.S. has only 5-15 µeq/L and, as such, is the most sensitive to acidification. This cluster had the lowest pH levels on the pH map (Fig. 7). Lakes in an arc to the west and north around this cluster show gradual increase in $Ca^{2+} + Mg^{2+}$ with distance toward the perimeter of the arc. Lakes just to the west of Saint John have 40-100 µeq/L, while lakes further west and north basically have 100-200 µeq/L. Oddly enough, the lake with the least $^*[Ca^{2+} + Mg^{2+}]$ in N.B. was just north of Saint John - apparently in the carboniferous sandstone stratum. Lakes in the rest of southern N.B. and eastern Nova Scotia have variable amounts of $^*[Ca^{2+}$ and $Mg^{2+}]$, but usually less than 100 µeq/L. Some lakes sampled in Cape Breton and northern N.B. had $^*[Ca^{2+} + Mg^{2+}]$ concentrations in excess of 300 ueq/L.

The lakes containing least $^*[Ca^{2+} + Mg^{2+}]$ lie on carboniferous granite and adjacent meguma slate and metamorphic formations in southwestern N.S. The nature of overlying till may be more

important in determining these levels rather than the bedrock. Farmer et al. (1980) have discussed the apparent importance of drumlin fields in buffering streams in this region. These drumlin fields are apparently more common toward the northeast portion of southwestern N.S. Similarly, although most lakes surveyed in N.B. lie on Devonian granite formations, those is the Lepreau area (e.g. lake numbers 4-24 in Fig. 1) have the least calcium and magnesium. This may be due to the nature of the till in this area. Kettles and Wyatt (1985) have analyzed the carbonate composition of tills in southwestern N.B., but did not include the Lepreau area in their study.

$[Ca^{2+} + Mg^{2+}]^*$ vs *SULFATE

One possible source of error involved in estimating lake acidification is the presence of Ca^{2+} or Mg^{2+} associated with SO_4^{2-} through dissolution of natural gypsom or $MgSO_4$ deposits. If $^*[Ca^{2+} + Mg^{2+}]$ is plotted vs $^*SO_4^{2-}$ for all Maritime lakes sampled, excluding five lakes with very high $^*[Ca^{2+} + Mg^{2+}]$, then a weak positive correlation exists (Fig. 14), implying a possible Ca- or Mg-SO_4 component. If taken at face value, one could conclude that 2/3 of the *Ca or *Mg is correlated with SO_4^{2-}. However no correlation is obtained for either the N.B. or N.S. subsets, if analyzed separately. The relationship thus depends upon the fact that N.B. lakes, in general, have both higher $^*SO_4^{2-}$ and higher $^*[Ca^{2+} + Mg^{2+}]$ than N.S. lakes. It is probable that southwestern N.B. receives a higher precipitation loading of SO_4^{2-} than does N.S. (Glass and Brydges 1981), so that the relationship for the provinces combined may be spurious due to coincidental higher sulfate and *Ca + *Mg in N.B.

BUFFER STATE

Henriksen (1982) described a theoretical relationship between $[^*Ca^{2+} + Mg^{2+}]$ and the bicarbonate content of pristine lakes (Alk = -14 + 0.93 (Ca^* + Mg^*)). Most data points for the N.B. and N.S. lakes indicate an apparent excess of Ca^{2+} + Mg^{2+} in relation to HCO_3^- (Fig. 15). This may be taken as an indication of loss of HCO_3^- through lake acidification. The horizontal distance of a particular data point from the theoretical line provides a measure of the amount of HCO_3^- which has been lost (the "alkalinity deficit"). The model assumes that no Ca^{2+} or Mg^{2+} in the lake water is associated with an organic anion - which may not be valid for highly colored lakes. The calculated deficit is also a function of season, at least for N.B. lakes (Peterson and Martin-Robichaud 1984). This survey was concentrated in July-August, at which times deficits should be near maximal. In general, the points representing Nova Scotian lakes lie closer to the line than those representing N.B. lakes, except for lakes from northern N.B. which lie near the theoretical line. The regional distribution of alkalinity deficits (Fig. 16) indicates that loss of neutralizing capacity, on the average has been greatest in southwestern N.B., followed by southwestern N.S. (deficits of 35 and 25 μeq/L, respectively). The small number of Cape Breton and northern N.B. lakes sampled show little loss of alkalinity, consistent with atmospheric loading patterns for the Maritimes (Underwood et al. 1981; Ferguson and Machta 1982) where northern N.B. and Cape Breton lie outside the pH 4.6 isopleth.

Henriksen also derived an empirical nomograph relating pH to lake $^*[Ca^{2+} + Mg^{2+}]^*$ and lake $^*SO_4^{2-}$ (Fig. 17, 18). In this empirical relationship, the regressions relating $^*[Ca^{2+} + Mg^{2+}]$ to $^*[SO_4^{2-}]$ for lake pH's of 5.3 and 4.7 are given particular importance. Lakes above the "pH 5.3" line are considered "bicarbonate", those between the 5.3 and 4.7 lines are "transitional", and those falling below the pH 4.7 line are "acidic." This particular model may not be as satisfactory for Maritime lakes, because pH is probably influenced more by weak organic acidity than is buffer capacity (Wiltshire and Machell 1981). There is also some uncertainty as to the actual SO_4^{2-} concentrations. The values, as measured with the turbidimetric method, are probably overestimates of true sulfate concentrations, irrespective of the DOC levels. Based upon comparisons with ion chromatographic values for lakes where both estimates are available, the turbidimetric values are probably high by about 15 μeq/L. We have deducted this from the turbidimetric estimates of SO_4^{2-} to construct the nomographs. It must be kept in mind, however, that this is an approximate correction, adding some additional uncertainty, particularly for lakes which are marginal in position. With the above proviso, the agreement of actual lake pH distributions with the empirical predictions is quite good. Almost all the lakes which should be transitional are. Of 69 N.B. lakes surveyed, 50 are classified as bicarbonate, 16 as transitional and 3 as acidic. Seventy-six Nova Scotian lakes were surveyed, of which 24 would be classified as bicarbonate, 23 as transitional, and 29 as acidic. According to the Henriksen nomogram, lake excess sulphates of 50-60 μeq/L (N.S. lakes with mean levels near 50, N. B. lakes near 60) correspond to precipitation pH levels of 4.5-4.6 — in good agreement with reported values.

A third model developed by Henriksen is probably the most informative of the three presented here (Fig. 19). This is an empirical model relating pH to $^*[Ca^{2+}]$ under pristine conditions. Lakes represented by points lying above the curve are considered to have been acidified, while those below the curve have not. Since pH is also influenced by organic acids, we have distinguished four classes of lakes in Fig. 19, based on DOC levels: <5; >5 <10; >10 <15; and >15 mg/L. The last two categories would be considered to be composed of "organic" lakes. We can see that lakes with more than 60 μeq/L $^*Ca^{2+}$, for the most part lie below the empirical curve - indicating non-acidification (in spite of the fact that alkalinity deficits of ca. 30 μeq/L were calculated for most of them) There is apparently still sufficient alkalinity to maintain these lakes below the curve. DOC appears to have no influence on the position of these buffered lakes on the graph up to 10 mg/L. The few lakes with >60 μeq/L $^*Ca^{2+}$ and more than 10 mg/L DOC do appear to have lower pH than the points representing lakes with less than 10 mg/L DOC. Lake pH declines rapidly as $^*Ca^{2+}$ declines from 50 to 30 μeq/L. These lakes are in the transitional phase of the lake titration model, and pH decreases more rapidly with decreasing $^*Ca^{2+}$ than predicted from the model, so that most lakes with less than 40 μeq/L $^*Ca^{2+}$ appear as acidified. This level of $^*Ca^{2+}$ corresponds pretty well with the 30 μeq/L of alkalinity which have been calculated to have been lost in these lakes due to acidification. For these acidified lakes, the amount of DOC does seem to influence pH. Regressions have been calculated for lakes in the three DOC classes and with less than 40

μeq/L $*Ca^{2+}$ which have sufficient points (Fig. 19) for such an analysis. Lakes with more DOC are more acidic below 40 μeq/L $*Ca^{2+}$, and the difference increases as the $*Ca^{2+}$ decreases. At extrapolation, the "0" $*Ca^{2+}$ lakes with less than 5 mg/L DOC are predicted to have a pH of 4.6; those with 5-10 mg/L DOC, a pH of 4.2; and those with 10-15 mg/L DOC, a pH of 4.0. Kerekes (1980) has reported differences of 0.2-1.0 in pH between clear and organic lakes in Kejimkujik National Park. It would thus appear, in general, that organic acidity below 10 mg/L has little effect on pH if there is bicarbonate alkalinity present. When the bicarbonate alkalinity is exhausted or lacking (at pH <5.5), then the presence of organic acids decreased the pH (by a maximum of approximately 0.06 pH units/mg/L of DOC at "0" $*Ca^{2+}$).

DISSOLVED METALS

Waters of more acidic lakes generally contain higher concentrations of total dissolved metals, such as aluminum and iron. The organic acid content of the lake water may also be important in sequestering metal concentrations, thus raising the capacity of the water to retain metal ions. A linear multiple regression of [Al] as a function of lake pH and lake DOC could account for 78% of the variability in total dissolved aluminum concentrations from all the lakes surveyed (Fig. 20); pH alone could account for 51% of the variability. The calculated equation is [Al] = 31.09 + 1.28 DOC - 5.10 pH, with Al being expressed in μeq/L - assuming a valence of +3 for aluminum. The dotted curves in Fig. 20 represent the solubility curve for all species of Al (Black 1967) in water with no organic chelating agents - the curves being positioned by connecting appropriate points on the isopleths. Within the area confined by the two curves, Al is essentially insoluble. Thus, it is apparent that Al cannot be in free solution at the concentrations determined in most of the lake samples. Probably organic-Al complexes are the primary Al species in these instances. The regression suggests that each mg increase in DOC results in increased bound Al by 1.3 μeq. The organic acids increase by about 11 μeq/L per mg DOC (Oliver 1981) so that Al probably occupies 10-15% of the anionic sites of organic acids present. For points lying outside the solubility curves, Al species in free solution could be major components of the total dissolved Al; although organic complexes may also occur, depending on the amounts of organic carbon present.

Water pH is much less important as a factor determining concentrations of total extractable iron than for aluminum - accounting for only 15% of the variability (Fig. 21). DOC and pH combined account for 61% of the variability with the multiple regression equation being [Fe] = 10.68 + 1.28 DOC - 2.06 pH. The coefficient for DOC is almost the same as the DOC coefficient in the multiple regression for Al while the pH coefficient is less than half. The relatively greater importance of organic anions on iron solubility is indicated in Fig. 21 by the near-vertical slope of the isopleths. Complete independence from pH would be indicated by perfectly vertical isopleths. The iron solubility curve again indicates that most Fe in the lake water samples cannot be in true solution, but is probably complexed with the organic anion. For lakes with pH <5.0, some free ionic iron is a possibility, as solubility increases greatly as the pH falls below 5.0. Wiltshire and Machell (1981) also found that levels of Al and Fe were influenced by both lake pH and lake DOC level.

In contrast to the correlations described above for Al and Fe, total extractable manganese in lake water showed no correlation with either pH or DOC. Values were uniformly low, usually ranging from 0.01 to 0.04 mg/L.

ION BALANCES

Any estimates of ion balance for these lake water samples are confronted with some uncertainty. Sulphate was determined turbidimetrically, probably resulting in an overestimate of this ion; as described previously. No attempt was made to include organic anions in the balance sheet as it was considered probable that SO_4^{2-} was overestimated, so that adding organic anions (using Oliver's equation) would overload the anion side of the budget. If Fe^{3+} and Al^{3+} were factored in, along with an organic anion estimate, the balance would still have been decidedly negative.

The balance was estimated by computing (on an equivalent basis) summed Na^+, Ca^{2+}, K^+ and H^+ and comparing against the sum of Cl^-, SO_4^{2-} and HCO_3^- (derived from alkalinity measurements). Most of the analyses resulted in good balances between sums of cations and anions with 132 of 145 lakes yielding <15% of zero net charge (Fig. 22). New Brunswick lakes were slightly biased toward a net positive charge (mean +2.6 μeq/L for 69 lakes), while Nova Scotian lakes were biased toward a net negative charge (-2.3 μeq/L for 76 lakes).

The estimated net charge tended toward greater positivity at higher DOC levels (Fig. 23); possibly due to the increasingly greater importance of organic anions at higher DOC levels. Only 2 of 28 Nova Scotia lakes with <5 mg/L DOC had a net positive charge, while only 1 of 15 with >10 mg/L DOC had a net negative charge. New Brunswick lakes had a consistently more positive bias than Nova Scotian lakes for all three DOC categories, possibly indicating a differing composition of the organic molecules in the less acid N.B. lakes.

Evidence as to whether or not a lake has been "acidified" is necessarily indirect in the absence of reliable historical chemistry data. The use of the Henriksen nomogram indicates that about 22 (29%) of Nova Scotian, and 3 (4.3%) of New Brunswick lakes sampled in the survey are acidic (i.e. SO_4^{2-}, rather than HCO_3^- dominated). Another 27 (36%) and 16 (23%), respectively, are transitional-acidified to near the endpoint of the bicarbonate titration curve. Kelso et al (1986), using these nomograms, reported 47.3% and 15.4% of Nova Scotia and New Brunswick lakes as acidified with 33.8% and 26.2%, respectively, being transitional. The higher percentages reported by Kelso et al. (1986) are no doubt due to the fact that corrected $*SO_4^{2-}$ values (15 μeq/L deducted) were used in this report. Kelso et al. (1986) commented on the apparent excessive $*SO_4^{2-}$ present relative to levels predicted by the Henriksen model.

Using Henriksen's empirical pH-*Ca curve, Haines and Akielaszek (1983) found 57% of 140 lakes surveyed in New England were presumably acidified, with acidified lakes occurring over the entire range of the curve (ca. 30-500 μeq/L Ca). In contrast, the results presented here indicate no acid lakes

with more than 100 µeq *Ca and most acidified lakes contained less than 40 µeq *Ca. A total of 62 (43%) would be considered acidified using this criterion. New England lakes receive higher acid loadings than do New Brunswick and Nova Scotia lakes, which may account for at least some of the differences discussed above. Scruton (1983), using the same criterion, concluded that 11% of Newfoundland lakes were acidified.

The data indicate an apparent agreement between geographic trends in sulpnate deposition and geographic trends in alkalinity losses. This is circumstantial evidence for a cause and effect relationship between the two phenomena. Johnson (1985) found a similar agreement for rivers draining into Georgian Bay. The extreme sensitivity of many southwestern Nova Scotia lake waters maximizes the impact of the alkalinity losses.

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Appendix 1. Geographic coordinates and description of lake characteristics for lakes surveyed.

New Brunswick Lake #1. (Connors)
Map Coordinates: 45°12' (Lat.); 66°14' (Long.)
Terrestrial vegetation surrounding lake: coniferous forest with low shrubs within 4-6 in of the shoreline; shore: covered with rock rubble and many tree stubs, no camps, but transmission line corridor nearby; aquatic vegetation: large patches of lily pads, mats of floating algae and filamentous submerged plants; lake substrate: fine gravel overlain by a thick layer of organic matter.

New Brunswick Lake #2. (Shadow)
Map Coordinates: 45°13' (Lat.); 66°18' (Long.)
Terrestrial vegetation surrounding lake: conifers coming right to the shoreline at some locations; shore: a Narrow 3.0-4.5 m wide area is exposed around much of the lake with several camps present at the south end along an accesss road leading to the lake; aquatic vegetation: lily pads and emergent vegetation in the small bays and pockets along the shore; lake substrate: sand overlain by a thick layer of organic matter.

New Brunswick Lake #3. (Perch)
Map Coordinates: 45°14' (Lat.); 66°16' (Long.)
Terrestrial vegetation surrounding lake: mixed forest; shoreline: scattered narrow bands of rocky shore exposed, scattered deadfalls, two camps on islands plus several boats on shore and south end of lake at end of access road; aquatic vegetation: large expanses of reed beds, also patches of pickerel weed (Pontederia cordata), lily pad; Lake substrate: generally gravel and small rocks overlain with organic matter.

New Brunswick Lake #4. (Labrador)
Map Coordinates: 45°19' (Lat.); 66°22' (Long.)
Terrestrial vegetation surrounding lake: mainly large expanses of bog and conifers close to the lake shore which is rocky, no camps were seen; lake substrate: boulders, covered with fine silt.

New Brunswick Lake #5. (Big Indian)
Map Coordinates: 42°21' (Lat.); 66°24' (Long.)
Terrestrial vegetation surrounding lake: conifers close to shore; shoreline: many large granitic boulders (and many small islands); aquatic vegetation: a few patches of lily pads; lake substrate: gravel overlain by a thin layer of organic matter.

New Brunswick Lake #6. (Moose)
Map Coordinates: 45°27' (Lat.); 66°28' (Long.)
Terrestrial vegetation surrounding lake: shrubs and mixed forest with a few dead spars interspersed; shoreline: sand beaches in north, east and west, marsh in the south, one camp and road at north end, trees and shrubs are close to shore in many areas; aquatic vegetation: lily pads and emergent reeds in north end, little elsewhere; lake substrate: sand inshore gives way to granitic gravel in deeper water.

New Brunswick Lake #7. (Emigrant)
Map Coordinates: 45°25' (Lat.); 66°32' (Long.)
Terrestrial vegetation surrounding lake: conifers very close to shore, interspersed with dead spars; shoreline: largely covered by labrador tea (Ledum groenlandicum), one camp was present; aquatic vegetation: patches of lily pads at the north end with dense bottom covering of foxtail-like plant and grasses; lake substrate: gravel with scattered boulders.

New Brunswick Lake #8. (Flagor)
Map Coordinates: 45°22' (Lat.); 66°23' (Long.)
Terrestrial vegetation surrounding lake: conifers and shrub cover close to the shore, no camps seen, scattered deadfalls; aquatic vegetation: scattered patches of lily pads, dense patches of submerged grasses; lake substrate: granitic gravel overlain with a thick layer organic matter.

New Brunswick Lake #9. (Caribou)
Map Coordinates: 45°25' (Lat.); 66°32' (Long.)
Terrestrial vegetation surrounding lake: mixed forest and shrubs close to shore; shoreline: few exposed areas were boulder-strewn, few deadheads, no camps seen; aquatic vegetation: little seen; lake substrate: large rocks and boulders.

New Brunswick Lake #10. (Loon)
Map Coordinates: 45°23' (Lat.); 66°30' (Long.)
Terrestrial vegetation surrounding lake: mixed forest and shrubs close to shore; shoreline: mainly rocky, with a few deadfalls; beaver dam at south end, sand beaches to the east; aquatic vegetation: little seen, patches of algae at south end; lake substrate: rock and gravel.

New Brunswick Lake #11. (Crystal)
Map Coordinates: 45°21' (Lat.); 66°31' (Long.)
Terrestrial vegetation surrounding lake: mixed forest with shrubs close to shore; shoreline: narrow bands of granitic rock and occasional sandy beaches, few deadfalls, two camps present (one on east side, one on west); aquatic vegetation: some sparse patches of lily pads extending well out into lake at north end; lake substrate: heavy boulders and gravel overlain with a thin layer of organic matter.

New Brunswick Lake #12. (Mosquite)
Map Coordinates: 45°16' (Lat.); 66°34' (Long.)
Terrestrial vegetation surrounding lake: conifers and shrubs cover most of shore; shoreline: scattered, exposed boulders, and a few narrow sandy stretches, no camps seen; aquatic vegetation: patches of submerged and attached Elodea-like plants; lake substrate: gravel overlain by organic matter.

New Brunswick Lake #13. (Bear)
Map Coordinates: 45°16' (Lat.); 66°34'(Long.)
Terrestrial vegetation surrounding lake: conifers and low shrubs surround most of shore; shoreline: ringed by exposed boulders, marshy area at north-end, no camps seen; aquatic vegetation: patches of lily pads.

New Brunswick Lake #14. (Adelaide)
Map Coordinates: 45°19' (Lat.); 66°39' (Long.)
Terrestrial vegetation surrounding lake: conifers, shrubs, and deadfalls around the shoreline, no camps seen; aquatic vegetation: patches of submergent and emergent grasses; lake substrate: large boulders and gravel.

New Brunswick Lake #15. (Tomoowa)
Map Coordinates: 45°21' (Lat.); 66°38' (Long.)
Terrestrial vegetation surrounding lake: predominantly conifers and shrubs close up to the shore, two camps seen; aquatic vegetation: patches of grasses.

New Brunswick Lake #16. (Mistake)
Map Coordinates: 45°22' (Lat.); 66°34' (Long.)
Terrestrial vegetation surrounding lake: conifers to within 3 m of lake with shrubs close to shore; shoreline: narrow band of whitish rocks, one camp.

New Brunswick Lake #17. (McCready)
Map Coordinates: 45°24' (Lat.); 66°34' (Long.)
Terrestrial vegetation surrounding lake: coniferous to within 3 m of shoreline; shore: much of it covered with large whitish rocks, one camp at end of access road; aquatic vegetation: patches of long grasses; lake substrate: overlain by heavy layer of organic matter.

New Brunswick Lake #18. (Ormond)
Map Coordinates: 45°20' (Lat.); 66°39' (Long.)
Terrestrial vegetation surrounding lake: conifers with shrubs close up to the shoreline: water level markedly different from Adelaide (underground connection unlikely), no access roads or camps seen.

New Brunswick Lake #19. (Clear)
Map Coordinates: 45°14' (Lat.); 66°42' (Long.)
Terrestrial vegetation surrounding lake: conifers with small shrubs close to shoreline; shore: narrow bands of rocks and gravel in some places, two camps; lake substrate: organic matter layer over fine clay bottom.

New Brunswick Lake #20. (Antonia)
Map Coordinates: 45°16' (Lat.); 66°43'(Long.)
Terrestrial vegetation surrounding lake: mixed forest close up to shoreline with intermittent narrow bands of rocky shore, and some grass and shrub cover; shore: road nearby, no camps; aquatic vegetation: patches of eel grass.

New Brunswick Lake #21. (Poqueawis)
Map Coordinates: 45°22' (Lat.); 66°43'(Long.)
Terrestrial vegetation surrounding lake: predominantly conifers, some deciduous with shrubs close up to shore, dead spars present, one camp and access road; aquatic vegetation: patches of partially submerged eel grass.

New Brunswick Lake #22. (Little Long)
Map Coordinates: 45°22' (Lat.); 66°49' (Long.)
Terrestrial vegetation surrounding lake: mainly conifers close to shore with shrubs (mainly alders) and dead spars, cleared areas at north west end of lake and south-southeast of lake; aquatic vegetation: eel grass all around shore, with patches of lily pads in the deeper water; also deadfalls.

New Brunswick Lake #23. (Smith)
Map Coordinates: 45°18' (Lat.); 66°40' (Long.)
Terrestrial vegetation surrounding lake: mixed forest and shrubs to within 1 m of shore; shoreline: ringed by rocks, scattered deadfalls, no camps; aquatic vegetation: patches of lily pads and Elodea-like plants.

New Brunswick Lake #24. (Lily)
Map Coordinates: 45°11' (Lat.); 66°54' (Long.)
Terrestrial vegetation surrounding lake: mainly conifers (and some shrubs) close to shore; shoreline: scattered large boulders along edge of lake, 3 camps; lake substrate: gravel overlain by organic matter.

New Brunswick Lake #25. (Creasey)
Map Coordinates: 45°14' (Lat.); 67°01' (Long.)
Terrestrial vegetation surrounding lake: conifers and some deciduous trees close to shore; shoreline: narrow stretch of fine gravel on eastern end, much wood litter on or near shore, newts seen amongst litter; three camps, two access roads; aquatic vegetation: patches of emergent grasses close to shore; lake substrate: fine gravel overlain by organic matter.

New Brunswick Lake #26. (St. Patricks)
Map Coordinates: 45°14' (Lat.); 67°02' (Long.)
Terrestrial vegetation surrounding lake: mainly conifers close to shore, thin band of rocks around some shore sections, open swampy areas at northwest end of lake, one access road; aquatic vegetation: patches of lily pads; lake substrate: gravel overlain by organic matter.

New Brunswick Lake #27. (Kerr)
Map Coordinates: 45°13' (Lat.); 67°01' (Long.)
Terrestrial vegetation surrounding lake: mixed forest with small shrubs close to shore; scattered exposed rocky areas, many camps on lake; aquatic vegetation: beds of Elodea-like plants seen.

New Brunswick Lake #28. (Welch)
Map Coordinates: 45°11' (Lat.); 67°05'(Long.)
Terrestrial vegetation surrounding lake: mainly conifers, sparsely spread around shore with open patches having shrubs close to shore, many islands, deadfalls, dead spars; aquatic vegetation: patches of lily pads, grasses; lake substrate covered by a thick layer of organic matter.

New Brunswick Lake #29. (Limeburners)
Map Coordinates: 45°11' (Lat.); 67°06' (Long.)
Terrestrial vegetation surrounding lake: mostly coniferous forest, some deciduous close to shore; shoreline: two access roads, five camps, a railroad line passes right by lake; aquatic vegetation: grasses and lily pads; lake substrate overlain by organic matter.

New Brunswick Lake #30. (Heart)
Map Coordinates: 45°27' (Lat.); 66°41' (Long.)
Terrestrial vegetation surrounding lake: some birches, with pine and other conifers, many deadfalls and spars, forest to 0-2 m from shore, shrubs from treeline to shore; shoreline: some rocks along shoreline, access road to lake; aquatic vegetation: lily pads, eel grass; lake substrate overlain by organic matter.

New Brunswick Lake #31. (Little Kedron)
Map Coordinates: 45°32' (Lat.); 66°58' (Long.)
Terrestrial vegetation surrounding lake: mixed forest - cedar, spruce, fir and some beech. Forest comes close to shore, little exposed shoreline, deadfalls and dead spars present, three or four camps nearby lake; aquatic vegetation: none seen; lake substrate: sand and clay overlain with organic matter.

New Brunswick Lake #32. (Little)
Map Coordinates: 45°35' (Lat.); 66°53' (Long.)
Terrestrial vegetation surrounding lake: mostly deciduous forest, some shrubs, and grassy shore; shoreline: grassy, and some exposed clay, road directly beside lake; aquatic vegetation: eel grass three-quarters of the way around the lake; lake substrate is overlain with organic matter.

New Brunswick Lake #33. (Tom Davis)
Map Coordinates: 45°48' (Lat.); 67°15' (Long.)
Terrestrial vegetation surrounding lake: spruce, fir, pine and other conifers, birch deadfalls, shrubs close to about 2 m from shore; large rocks ring the shoreline interspersed with some swampy areas and grassy areas; lake substrate: organic matter.

New Brunswick Lake #34. (Deer Lake)
Map Coordinates: 45°49' (Lat.); 67°24' (Long.)
Terrestrial vegetation surrounding lake: east side has shrubs and birches close to shore, west side mostly coniferous, a few large rocks are exposed along the shoreline; a railroad line runs along one side of the lake, there is large cleared area where the railroad passes, and one house; aquatic vegetation: grasses and lily pads; lake substrate: overlain by a thick layer of organic matter (mainly wood chips).

New Brunswick Lake #35. (Pear)
Map Coordinates: 45°52' (Lat.); 67°22'(Long.)
Terrestrial vegetation surrounding lake: mostly deciduous, some birches right up to shore; shoreline: there are two areas completely exposed; lake substrate: mud and organic matter.

New Brunswick Lake #36. (Mud)
Map Coordinates: 45°50' (Lat.); 67°11' (Long.)
Terrestrial vegetation surrounding lake: mixed forest (mainly cedar) surrounding lake, many deadfalls; shoreline: most of shoreline is boggy, and much of lake is invaded by grasses and bog plants, one access road; aquatic vegetation: large patches of lily pads, abundant grasses; lake substrate: boulders and organic matter, mud in some areas.

New Brunswick Lake #37. (Big Duck)
Map Coordinates: 45°47' (Lat.); 67°19' (Long.)
Terrestrial vegetation surrounding lake: mostly deciduous forest (birch), some conifers (cedar, spruce) with a ring of rocks along shoreline; aquatic vegetation: patches of lily pads; lake substrate overlain by organic matter.

New Brunswick Lake #38. (Foster))
Map Coordinates: 45°37' (Lat.); 67°18' (Long.)
Terrestrial vegetation surrounding lake: mixed forest and grassy areas, rocks along the shore; swamp land on a portion of the western side of the lake, a railroad passes along one side of the lake; aquatic vegetation: pickeral weeds, lily pads, and grasses; lake substrate: mud overlain with organic matter.

New Brunswick Lake #39. (Tomilson)
Map Coordinates: 45°39' (Lat.); 69°22' (Long.)
Terrestrial vegetation surrounding lake: mixed forest, some deadfalls and spars, coniferous shrubs along shore, some places 9 m from shore to trees; shoreline: some large rocks scattered along shoreline; aquatic vegetation: lily pads and grasses; lake substrate: mud and organic matter.

New Brunswick Lake #40. (Grassy)
Map Coordinates: 45°49' (Lat.); 67°29' (Long.)
Terrestrial vegetation surrounding lake: coniferous forest, some deadfalls, grassy shoreline and in some areas swampland, and grassy areas; rocks exposed along shore, islands; aquatic vegetation: mats of floating grasses; lake substrate overlain by thick layer of organic ooze.

New Brunswick Lake #41. (East Brook)
Map Coordinates: 45°41' (Lat.); 67°31' (Long.)
Terrestrial vegetation surrounding lake: forested up close to shore in most areas, intermittent open areas; with scattered rocks exposed in lake around the shore; one access road nearby; lake substrate: mud and sand overlain with organic matter.

New Brunswick Lake #42. (Sixth)
Map Coordinates: 45°43' (Lat.); 67°27'(Long.)
Terrestrial vegetation surrounding lake: mostly coniferous forest with shrubs close to shore; shoreline: rocky, one access road, one camp; aquatic vegetation: lily pads; lake substrate: rocks covered with algae slime near shore, muddy in center overlain with organic matter.

New Brunswick Lake #43. (Bolton)
Map Coordinates: 45°42' (Lat.); 67°35' (Long.)
Terrestrial vegetation surrounding lake: mixed forest to 3-5 m from shore; shoreline: areas of boulders and sandy beaches along shoreline, one camp seen and one access road is nearby the lake; aquatic vegetation: grasses and lily pads; lake substrate: gravel, boulders overlain with organic matter.

New Brunswick Lake #44. (Musquash)
Map Coordinates: 45°41' (Lat.); 67°38' (Long.)
Terrestrial vegetation surrounding lake: mixed forest and some grassy areas up to shoreline, some rocks around shore, one cabin; aquatic vegetation: lily pads; lake substrate: rocky.

New Brunswick Lake #45. (La Coote)
Map Coordinates: 45°46' (Lat.); 67°32' (Long.)
Terrestrial vegetation surrounding lake: mixed forest (mostly coniferous), some shrubs to very near the shore, some rocks along shore, marshy area on southeastern end, one cabin; aquatic vegetation: scattered lily pads; lake substrate: rocky and muddy overlain with organic matter.

New Brunswick Lake #46. (Third Eel)
Map Coordinates: 45°46' (Lat.); 67°34' (Long.)
Terrestrial vegetation surrounding lake: mixed forest, mostly coniferous, a few shrubs near shore, deadfalls and spars some rocks exposed along shoreline; aquatic vegetation: lily pads, an algal bloom; lake substrate: rocks overlain with algal slime near shore, muddy in center overlain with organic matter.

New Brunswick Lake #47. (Skiff)
Map Coordinates: 45°49' (Lat.); 67°32' (Long.)
Terrestrial vegetation surrounding lake: forest area around lake, with rocky shore, numerous tree-covered islands also with rocky shores; shoreline: there is a major access road and numerous cabins around lake; lake substrate: rocky, sandy with a thin layer of organic matter.

New Brunswick Lake #48. (Ingraham)
Map Coordinates: 45°56' (Lat.); 67°21' (Long.)
Terrestrial vegetation surrounding lake: coniferous forest with little exposed shoreline but scattered rocks exposed, many deadfalls, one large camp, one island with rocky shoreline; aquatic vegetation: reed beds; lake substrate: mud and organic matter.

New Brunswick Lake #49. (Brown)
Map Coordinates: 45°56' (Lat.); 67°18'(Long.)
Terrestrial vegetation surrounding lake: mixed forest, shrubs close to shore, little exposed shoreline except for some large rocks scattered along shore, many cabins; aquatic vegetation: emergent grasses, lily pads, abundant pickerel weeds; lake substrate: grey clay overlain with organic matter.

New Brunswick Lake #50. (Davison)
Map Coordinates: 45°56' (Lat.); 67°09' (Long.)
Terrestrial vegetation surrounding lake: mixed forest (mostly coniferous); shoreline: some shoreline exposed (gravel), two access roads and numerous cabins; aquatic vegetation: many cattails, grassy at one end, many lily pads; lake substrate: mud with thick layer of organic matter (mainly grass).

New Brunswick Lake #51. (Howard Peak)
Map Coordinates: 46°15' (Lat.); 67°04' (Long.)
Terrestrial vegetation surrounding lake: coniferous stand with deadfalls and dead spars, trees right to edge of shore except in small cleared areas; shoreline: appears to be forest cutting activity in the area; aquatic vegetation: none seen; lake substrate: mud and organic matter, near shore lots of detritus (wood chips).

New Brunswick Lake #52. (Doughboy)
Map Coordinates: 46°23' (Lat.); 67°13' (Long.)
Terrestrial vegetation surrounding lake: coniferous forest followed by grasses up to shoreline;1 more like a swamp than a lake, much of area around it is grass and mud, one old cabin present; aquatic vegetation: grasses; lake substrate: organic matter (decomposed) plus grasses and mud.

New Brunswick Lake #53. (Nashwaak)
Map Coordinates: 46°28' (Lat.); 67°07' (Long.)
Terrestrial vegetation surrounding lake: deciduous forest with small shrubs; shoreline: one section of shoreline is sandy, one camp near lake; lake substrate: sand overlain with organic matter.

New Brunswick Lake #54. (Moose)
Map Coordinates: 46°51' (Lat.); 66°47' (Long.)
Terrestrial vegetation surrounding lake: mixed forest up to shoreline, little exposed shoreline except for narrow rocky edge around lake; shoreline: four camps (private fishing lodge), two access roads; lake substrate: mud and organic matter.

New Brunswick Lake #55. (Beaver Brook)
Map Coordinates: 45°44' (Lat.); 66°54' (Long.)
Terrestrial vegetation surrounding lake: mixed forest followed by shrubs up to shoreline, little exposed shoreline; one camp on lake; lake substrate: mud and organic matter.

New Brunswick Lake #56. (South Oromocto)
Map Coordinates: 45°24' (Lat.); 66°38'(Long.)
Terrestrial vegetation surrounding lake: mixed forest and shrubs along shore; shoreline: some beaches, swamp at southern tip, some scattered rocks along shore, numerous access roads, numerous cabins and trailers; aquatic vegetation: scattered lily pads; lake substrate: boulders, sand, gravel, some organic matter.

New Brunswick Lake #57. (Half Mile)
Map Coordinates: 47°19' (Lat.); 66°18' (Long.)
Accessibility: nearby roads; 3/4 of lake perimeter treed; 3 m exposed shoreline from shore to treeline; 3/4 shoreline grassy; vegetation: coniferous forest; many dead spars, few elodea covering 1/4 of lake surface; lake features: cottages present; lake substrate: detritus covered rock seen from gill net set; thick organic layer from Eckman sample.

New Brunswick Lake #58. (Kenny)
Map Coordinates: 47°14' (Lat.); 66°19' (Long.)
Accessibility: no road; 7/8 of lake perimeter treed; 1 m exposed shoreline between shore and treeline; less than 1/8 of shoreline was grassy; vegetation: coniferous forest; few dead spars; emergent reeds covering 1/8 of lake surface; lake features: few exposed rocks and islands; lake substrate: rock and boulders seen from gill net set; thick organic layer from Eckman sample.

New Brunswick Lake #59. (Slack's)
Map Coordinates: 47°11' (Lat.); 66°21' (Long.)
Accessibility: no road; 3/4 of lake perimeter treed; 3 m exposed shoreline between shore and treeline; 3/4 of shoreline grassy; vegetation: coniferous forest; lake features: few exposed rocks and islands; lake substrate: detritus covered gravel seen from gill net set; thick organic layer from Eckman sample.

New Brunswick Lake #60. (Island)
Map Coordinates: 47°37' (Lat.); 66°25' (Long.)
Accessibility: nearby roads; 5/8 of lake perimeter treed; 1 m exposed shoreline between shore and treeline; 1/2 of shoreline boggy areas; 1/4 shoreline grassy; vegetation: coniferous forest; few dead spars; lake features: cottages; wharf; few islands; lake substrate: detritus covered boulders seen from gill net set; thick organic layer from Eckman sample.

New Brunswick Lake #61. (Lovall's)
Map Coordinates: 47°26' (Lat.); 66°59' (Long.)
Accessibility: road 1/2 mile away; 1/8 of lake perimeter treed; 10 m exposed shoreline between shore and treeline; 1/2 shoreline boggy areas; 1/2 shoreline grassy; vegetation: coniferous forest; many dead spars; emergent reeds covering 1/8 of lake; lily pads covering 3/4 of lake surface; lake features: few islands; lake substrate: bog seen from gill net set; thick organic layer from Eckman sample.

New Brunswick Lake #62. (Jack's)
Map Coordinates: 46°58' (Lat.); 66°39' (Long.)
Accessibility: no road; 7/8 of lake perimeter treed; 0-1 m exposed shoreline between shore and treeline; 1/4 of shoreline grassy; vegetation: coniferous forest and grasses; pickerel weeds covering 3/8 lake surface; lake substrate: detritus covered boulders seen from gill net set; thick organic layer from Eckman sample.

New Brunswick Lake #63. (Dark)
Map Coordinates: 47°01' (Lat.); 66°42' (Long.)
Accessibility: no road; 7/8 of lake perimeter treed; 0.5 m exposed shoreline from shore to treeline; vegetation: coniferous forest; few dead spars; lake features: cottages; many exposed rocks; lake substrate: detritus covered boulders seen from gill net set; thick organic layer from Eckman sample.

New Brunswick Lake #64. (McLean)
Map Coordinates: 46°07' (Lat.); 65°45' (Long.)
Accessibility: no road; 1/8 of lake perimeter treed; 10 m or less of shoreline exposed from shore to treeline; vegetation: coniferous forest; open shore with grasses and bog plants; 1/8 of lake covered with lily pads; lake features: beaver lodge; few exposed rocks and islands; lake substrate: detritus covered bottom seen from gill net set; thick organic layer from Eckman sample.

New Brunswick Lake #65. (Sadler)
Map Coordinates: 45°19' (Lat.); 65°48' (Long.)
Accessibility: nearby roads; all of lake perimeter treed; 1/4 of shoreline rocky; less than 1/8 grassy; vegetation: mixed forest and grasses, few dead spars; emergent reeds and lily pads each covering less than 1/8 of lake; lake substrate: boulders seen from gill net set; vegetation from Eckman sample.

New Brunswick Lake #66. (Floods)
Map Coordinates: 45°37' (Lat.); 65°16' (Long.)
Accessibility: nearby roads; 7/8 of lake perimeter treed; 1/4 of shoreline rocky; 3/4 grassy; vegetation: mainly coniferous forest with some deciduous trees; many dead spars; 1/8 of lake covered with lily pads; lake features: few exposed rocks and islands; lake substrate: rock seen from gill net set; thick organic layer from Eckman sample.

New Brunswick Lake #67. (Mary Pitcher)
Map Coordinates: 45°30' (Lat.); 65°24' (Long.)
Accessibility: Track approximately 200 m from lake; 3/4 of lake perimeter treed; 0.5 m of exposed shoreline from shore to treeline; 1/4 shoreline boulder, 1/4 grassy; vegetation: mainly coniferous forest; some bog plants; few dead spars; lily pads covering approximately 1/4 of lake; lake features: few exposed rocks; lake substrate: rock seen from gill net set; thick organic layer and vegetation from Eckman sample.

New Brunswick Lake #68. (Henry)
Map Coordinates: 45°25' (Lat.); 65°36' (Long.)
Accessibility: nearby roads; 7/8 of lake perimeter treed; vegetation: mixed forest; some grasses; few dead spars; emergent reeds and lily pads each covering 1/8 of lake; lake features: cottages; boats; lake substrate: detritus covered gravel seen from gill net set; thick organic layer from Eckman sample.

New Brunswick Lake #69. (Theobald)
Map Coordinates: 45°29' (Lat.); 65°31' (Long.)
Accessibility: road directly to lake; all of shoreline treed; 0 m of exposed shoreline from shore to treeline; less than 1/8 of shoreline covered with rock or boulder; vegetation: mixed forest; few dead spars; 1/8 of lake covered by emergent reeds; 1/2 with lily pads; lake features; evidence of some lumbering; many exposed rocks and one island; lake substrate: rock seen from gill net set; clay and vegetation from Eckman sample.

Nova Scotia Lake #1. (Crosskill)
Map Coordinates: 44°52'(Lat.); 65°19'(Long.)
Terrestrial vegetation surrounding lake (a reservoir): mixed forest mainly desiduous, shrubs and grasses in front of trees to within 5-8 m of shore; two islands; shoreline: some patches of exposed rocks in areas where shrub and grass cover was not present, one building present and access road close by; aquatic vegetation: lily pads near shore; lake substrate: mud bottom overlaid with organic matter.

Nova Scotia Lake #2. (Lower Wrights)
Map Coordinates: 44°44'(lat.); 65°22'(Long.)
Terrestrial vegetation surroundng lake: mostly softwood, few shrubs interspersed among trees, right up to shoreline except for a few areas where large rocks are present; five to ten cottages, and access road close; aquatic vegetation: emergent reeds around shoreline; lake substrate: fine gravel overlaid with organic matter.

Nova Scotia Lake #3. (Goldsmith)
Map Coordinates: 44°44'(lat.); 65°18'(Long.)
Terrestrial vegetation surrounding the lake: mixed forest to 1 - 4 m from shore; many islands; some intermittent grassy areas, some rocks; no shoreline development, however, there are 2 access roads; very little aquatic vegetation; very rocky lake substrate.

Nova Scotia Lake #4. (West Stoney)
Map Coordinates: 44°41'(Lat.); 65°27'(Long.)
Terrestrial vegetation surrounding the lake: mixed forest, mostly softwood up to 1 - 3 m from shore, no camps; shoreline: small rocks, some stretches of gravel; aquatic vegetation: marshy area with lily pads and labrador tea at south end; lake substrate: organic matter over sand and gravel.

Nova Scotia Lake #5. (Dargie)
Map Coordinates: 44°39'(Lat.); 65°20'(Longs.)
Terrestrial vegetation surrounding lake: mixed hard and softwood forest to 5-8 m of shore; shoreline: rocky exposed shoreline and some swampy stretches; aquatic vegetation: sparse; lake substrate: rocky or boulder bottom.

Nova Scotia Lake #6. (Long)
Map Coordinates: 44°39'(Lat.); 65°14'(Long.)
Terrestrial vegetation surrounding lake: softwood forest, sapling and softwood size to within 5-9 m of shore, bog at one end; three camps and access road nearby lake; lake substrate: fine gravel overlaid with organic matter.

Nova Scotia Lake #7. (Lake of Five Hardwood Hills)
Map Coordinates: 44°39'(Lat.); 65°08'(Long.)
Terrestrial vegetation surrounding the lake: mixed hardwood and softwood forest to 1-4 m from shore, no camps, one access road; aquatic vegetation: lily pads at one end of lake; lake substrate: mud overlain with organic matter.

Nova Scotia Lake #8. (Bear)
Map Coordinates: 44°35'(Lat.); 63°13'(Long.)
Terrestrial vegetation surrounding lake: softwood forest to 1-2 m of shore; some grassy areas along shore, some rocks, beach at one end, no development or access roads; aquatic vegetation: plentiful.

Nova Scotia Lake #9. (Oak)
Map Coordinates: 44°31'(lat.); 65°24'(Long.)
Terrestrial vegetation surroundng lake: softwood forest to 2-3 m of shore; many exposed rocks in lake; no camps seen, no access roads, 3 islands; lake substrate: partly rock-strewn.

Nova Scotia Lake #10. (LeMarchant)
Map Coordinates: 44°30'(lat.); 65°33'(Long.)
Terrestrial vegetation surrounding the lake: softwood and hardwood forest to 1-3 m of shore; rocks on some areas of shoreline; at one end there are two bogs, there are several camps, one area cleared, there are two access roads; aquatic vegetation: some scattered emergent plants along shoreline; lake substrate: fine gravel bottom.

Nova Scotia Lake #11. (Four Mile)
Map Coordinates: 44°34'(Lat.); 65°27'(Long.)
Terrestrial vegetation surrounding the lake: softwood and hardwood forest to 1-3 m of shore; some rocky shorelines, some bogs, logging and some scarifying in one area, two access roads and one camp; aquatic vegetation: little seen.

Nova Scotia Lake #12. (Little Tom Wallace)
Map Coordinates: 44°28'(Lat.); 65°41'(Longs.)
Terrestrial vegetation surrounding lake: softwood forest to 1 m from shore in most places, however intermittent open grassy areas, some large rocks along shore; road passes nearby lake, no camps; aquatic vegetation: none seen; lake substrate: overlain by organic matter.

Nova Scotia Lake #13. (Franklin)
Map Coordinates: 44°27'(Lat.); 65°31'(Long.)
Terrestrial vegetation surrounding lake: softwood forest to 1-2 m of shore; some rocks along shoreline, some cleared areas and swampy areas, one access road; aquatic vegetation: area of lily pads at one end of lake.

Nova Scotia Lake #14. (Rocky Daniels)
Map Coordinates: 44°24'(Lat.); 65°30'(Long.)
Terrestrial vegetation surrounding the lake: softwood and hardwood forest to within 1 m of shore; rocky shoreline with intermittent grassy areas; a few islands, no camps; aquatic vegetation: none seen.

Nova Scotia Lake #15. (Moosehead)
Map Coordinates: 44°19'(Lat.); 65°30'(Long.)
Terrestrial vegetation surrounding lake: softwood trees in areas where there are no bogs; much of shoreline is exposed bog; aquatic vegetation: abundant; lake substrate: rocky bottom.

Nova Scotia Lake #16. (East Cranberry)
New Coordinates: 44°15'(Lat.); 65°35'(Long.)
Terrestrial vegetation surrounding lake: softwood forest to 3-4 m from shore; shoreline: about half the shoreline is completley exposed (boggy and rocky areas); aquatic vegetation: some lily pads, but not very abundant; lake substrate: mud overlaid with organic matter.

Nova Scotia Lake #17. (Junction)
Map Coordinates: 44°14'(Lat.); 65°23'(Long.)
Terrestrial vegetation surroundng lake: mixed softwood and hardwood forest to 1-4 m from shore; shoreline: some of shoreline is completely exposed with grass present, one area of swampland on one side, one road passes nearby lake, but no camps; aquatic vegetation: pitcher plants, but little else; lake substrate: mud overlaid by organic matter.

Nova Scotia Lake #18. (East Bingay)
Map Coordinates: 44°14'(lat.); 65°22'(Long.)
Terrestrial vegetation surrounding the lake: softwood forest (mainly pine) to 3 m from shore; shoreline: road passes by lake but no camps seen; aquatic vegetation: little seen; lake substrate overlain with organic matter.

Nova Scotia Lake #19. (Great Pine)
Map Coordinates: 44°13'(Lat.); 65°22'(Long.)
Terrestrial vegetation surrounding the lake: white pine forest to shoreline in some places but about 70% of shoreline exposed with some rocks at shoreline, one access road passes by lake, but no camps seen; aquatic vegetation: little seen; lake substrate: fine gravel overlaid with organic matter.

Nova Scotia Lake #20. (Handsled)
Map Coordinates: 44°12'(Lat.); 65°22'(Long.)
Terrestrial vegetation surrounding lake: predominantly softwood forest to 0-3 m from shore; shoreline: swamp in one corner of lake, access road to lake, two islands, scattered rocks exposed in lake particularly close to north shore; aquatic vegetation: none seen; lake substrate: bolders.

Nova Scotia Lake #21. (Second Beaver)
Map Coordinates: 44°13'(Lat.); 65°19'(Long.)
Terrestrial vegetation surrounding lake: softwood forest (mainly pine) to 1-3 m from shore but with intermittent open areas without trees particularly around north shore, an access road nearby, no camps, many exposed rocks in lake especially close to shore; aquatic vegetation: none seen; lake substrate: mud overlain with organic matter.

Nova Scotia Lake #22. (Torment)
Map Coordinates: 44°30'(Lat.); 65°21'(Long.)
Terrestrial vegetation surrounding the lake: mixed forest followed by shrubs right up to the shoreline; some boulders, many deadheads, access road passes nearby lake but no camps seen; aquatic vegetation: patches of lily pads, emergent weeds, some out near the center of lake; lake substrate: fine gravel overlain with small amount of organic matter in some places, boulder-strewn in others.

Nova Scotia Lake #23. (Little Tupper)
New Coordinates: 44°25'(Lat.); 65°58'(Long.)
Terrestrial vegetation surrounding lake: mixed forest, followed by shrubs or grass; shoreline: several camps, small sawmill, farmer's field, road right by lake; aquatic vegetation: pickerel weeds close to shore in marshy area at south end; lake substrate: boulders, some mud overlain with organic matter.

Nova Scotia Lake #24. (Clearwater)
Map Coordinates: 44°13'(Lat.); 65°34'(Long.)
Terrestrial vegetation surroundng lake: softwood forest to 1 m of shore on one side, the other side of lake grassy - very few trees; many rocks along shoreline, no development or access roads; aquatic vegetation: abundant; lake substrate: mud overlain with organic matter.

Nova Scotia Lake #25. (Buckshot))
Map Coordinates: 44°13'(lat.); 65°33'(Long.)
Terrestrial vegetation surrounding the lake: softwood forest to 1 m of shore; many rocks along shoreline, some intermittant grassy areas, swampland on one edge of lake; lake substrate: mud overlain with organic matter.

Nova Scotia Lake #26. (Hannah)
Map Coordinates: 44°09'(Lat.); 65°35'(Long.)
Terrestrial vegetation surrounding the lake: softwood forest to 1-2 m from shore; many rocks along edge of lake, 4 islands, swamp at one edge of lake, 1 camp and one access road; aquatic vegetation: little seen.

Nova Scotia Lake #27. (Clyde)
Map Coordinates: 44°07'(Lat.); 65°36'(Long.)
Terrestrial vegetation surrounding lake: softwood forest to 0-1 m from shore except west side of lake which is exposed rock; there are also some grassy areas; aquatic vegetation: little seen.

Nova Scotia Lake #28. (Lake with a Rock)
Map Coordinates: 44°07'(Lat.); 65°33'(Long.)
Terrestrial vegetation surrounding lake: mixed forest up to 1-2 m of shoreline, east side of lake totally exposed, swamp along one edge of lake; many exposed rocks throughout lake, 4 islands, no development; lake substrate: mud overlain with some organic matter.

Nova Scotia Lake #29. (Sabeans)
Map Coordinates: 44°05'(Lat.); 65°33'(Long.)
Terrestrial vegetation surrounding the lake: softwood forest to 3-5 m from shore, access road and camps present; lake substrate: mud overlaid with organic matter.

Nova Scotia Lake #30, (Solomon)
Map Coordinates: 44°03'(Lat.); 65°44'(Long.)
Terrestrial vegetation surrounding lake: mixed hardwood and softwood forest to 1 m from shore; shoreline: some camps, two access roads; aquatic vegetation: none seen; lake substrate: organic matter.

Nova Scotia Lake #31. (Nepsedek)
New Coordinates: 44°02'(Lat.); 65°46'(Long.)
Terrestrial vegetation surrounding lake: softwood forest to 1-2 m from shore; swampland around some of lake shore; aquatic vegetation: patches of lily pads; lake substrate: overlain with organic matter.

Nova Scotia Lake #32. (Mushpauk)
Map Coordinates: 43°51'(Lat.); 65°49'(Long.)
Terrestrial vegetation surroundng lake: mixed softwood and hardwood trees, mostly open exposed around lake; shoreline: extensive swampland on one end, three access roads, two camps.

Nova Scotia Lake #33. (Peters))
Map Coordinates: 43°59'(lat.); 65°47'(Long.)
Terrestrial vegetation surrounding the lake: mixed softwood and hardwood trees to 0-1 m of shore; some grassy areas at shoreline, road passes nearby lake, but no camps seen; aquatic vegetation: patches of emergent reeds; lake substrate: rocky.

Nova Scotia Lake #34. (Spar)
Map Coordinates: 45°53'(Lat.); 65°40'(Long.)
Terrestrial vegetation surrounding the lake: softwood and hardwood to 1-2 m of shore; large rocks found on edge of part of lake and some in the middle of lake; shoreline: swampland on south and north ends, 1 access road and 1 camp; aquatic vegetation: patches of emergent reeds; lake substrate: mud overlain with organic matter

Nova Scotia Lake #35. (Bald Mountain)
Map Coordinates: 44°04'(Lat.); 65°24'(Long.)
Terrestrial vegetation surrounding lake: mixed softwood and hardwood to 0-1 m of shore; lake substrate: mud overlaid with organic matter.

Nova Scotia Lake #36. (Rocky)
Map Coordinates: 44°02'(Lat.); 65°35'(Long.)
Terrestrial vegetation surrounding lake: hardwood and softwood trees, large open areas around lake; area of swampland on west side of lake.

Nova Scotia Lake #37. (Scrag(S))
Map Coordinates: 44°36'(Lat.); 64°55'(Long.)
Terrestrial vegetation surrounding the lake: softwood forest to 2 m from shore; shoreline: one camp on shore; aquatic vegetation: little seen; lake substrate overlain with organic matter.

Nova Scotia Lake #38, (Nimchin Page)
Map Coordinates: 44°48'(Lat.); 64°42'(Long.)
Terrestrial vegetation surrounding lake: hardwood mostly birches to 1-2 m from shore; bushes cover area from trees to shoreline; shoreline: two access roads to lake; aquatic vegetation: little seen; lake substrate: sand overlain with organic matter.

Nova Scotia Lake #39. (Frog)
New Coordinates: 44°50'(Lat.); 64°51'(Long.)
Terrestrial vegetation surrounding lake: hardwood forest, mainly birch to 1-2 m from shore, with grasses close to shore and large rocks along shore; aquatic vegetation: emergent reeds and lilies; lake substrate: sandy.

Nova Scotia Lake #40. (Birch)
Map Coordinates: 44°53'(Lat.); 64°52'(Long.)
Terrestrial vegetation surroundng lake: softwood forest to 1-2 m from shore; shoreline: one access road, rocks along shore; aquatic vegetation: abundant; lake substrate: organic matter.

Nova Scotia Lake #41. (Scrag(N))
Map Coordinates: 44°47'(lat.); 64°59'(Long.)
Terrestrial vegetation surrounding the lake: softwood and hardwood forest to 3 m from shore; areas of exposed rocks; many islands, one access road with bridge, no camps seen; aquatic vegetation: little seen; lake substrate: heavy gravel, chunks of granite.

Nova Scotia Lake #42. (Durland)
Map Coordinates: 44°35'(Lat.); 65°02'(Long.)
Terrestrial vegetation surrounding the lake: softwood forest to 1-2 m from shore; some islands and scattered rocks exposed in the lake, rocky shoreline; aquatic vegetation: abundant; lake substrate: stones overlain with organic matter.

Nova Scotia Lake #43. (Miletree)
Map Coordinates: 44°41'(Lat.); 64°57'(Long.)
Terrestrial vegetation surrounding lake: mixed forest and labrador tea to shoreline; shoreline: little exposed shoreline, one camp, one access road; aquatic vegetation: lily pads and emergent grasses, patches of Eriocaulon septangulare; lake substrate: large boulders overlain with organic matter, other areas open bottom covered with organic matter.

Nova Scotia Lake #44. (Skull Bog)
Map Coordinates: 44°35'(Lat.); 65°01'(Long.)
Terrestrial vegetation surrounding lake: softwood forest to 0-1 m from shore; a lot of shoreline is swampland; aquatic vegetation: lilies, emergent reeds; lake substrate: rocky.

Nova Scotia Lake #45. (Little Wallubec)
Map Coordinates: 44°02'(Lat.); 65°44'(Long.)
Terrestrial vegetation surrounding the lake: some mixed forest around lake to within 2-3 m of lake with most of shoreline bordered by grasses; aquatic vegetation: little seen; lake substrate: overlain with organic matter.

Nova Scotia Lake #46, (Lake George)
Map Coordinates: 44°56'(Lat.); 64°42'(Long.)
Terrestrial vegetation surrounding lake: softwood and hardwood forest to 0-1 m from shore; shoreline: one cleared area at one end, many camps and access roads; aquatic vegetation: emergent reeds and lilies; lake substrate: coarse sand.

Nova Scotia Lake #47. (Lewis)
New Coordinates: 44°47'(Lat.); 64°23'(Long.)
Terrestrial vegetation surrounding lake: mixed deciduous and conifers, shrubs mixed in with trees to shoreline; some granite rubble beaches, many camps, major highway skirts the lake; aquatic vegetation: some lily pads, deadheads in water; lake substrate: granite rubble.

Nova Scotia Lake #48. (Butler)
Map Coordinates: 44°43'(Lat.); 64°40'(Long.)
Terrestrial vegetation surroundng lake: mixed hardwood and softwood forest to 1-2 m from shore; shoreline: one access road to lake; aquatic vegetation: emergent reeds and lilies; lake substrate: boulders and sand overlain with thin layer of organic matter.

Nova Scotia Lake #49. (Colwell Round)
Map Coordinates: 44°51'(lat.); 64°36'(Long.)
Terrestrial vegetation surrounding the lake: predominantly softwood forest to 1-2 m from shore, one access road, no camps; aquatic vegetation: emergent reeds; lake substrate: overlain by organic matter.

Nova Scotia Lake #50. (Salmontail)
Map Coordinates: 44°50'(Lat.); 64°33'(Long.)
Terrestrial vegetation surrounding the lake: softwood forest to 3-5 m from shore; many islands and patches of rock; a lot of shoreline is swampland, the remainder is rocky, one access road; aquatic vegetation: none seen; lake substrate: organic matter over rocky substrate.

Nova Scotia Lake #51. (Crooked)
Map Coordinates: 44°55'(Lat.); 64°33'(Long.)
Terrestrial vegetation surrounding lake: mixed forest to 0-1 m from shore; one road passes by lake; lake substrate: overlain with organic matter.

Nova Scotia Lake #52. (Dean Chapter)
Map Coordinates: 44°53'(Lat.); 64°25'(Long.)
Terrestrial vegetation surrounding lake: mostly softwood forest to 0-1 m from shore; some rocky areas, but much of shoreline is swampland, there are a few camps and one access road; lake substrate: boulder bottom.

Nova Scotia Lake #53. (Bagpipe)
Map Coordinates: 44°32'(Lat.); 64°31'(Long.)
Terrestrial vegetation surrounding the lake: mixed softwood and hardwood forest to 1-3 m from shore; in one more open area the shoreline is rocky; lake substrate: overlain with organic matter.

Nova Scotia Lake #54. (Boarsback)
New Coordinates: 44°09'(Lat.); 65°67'(Long.)
Terrestrial vegetation surrounding lake: mixed forest and shrubs that come close to the shore; shoreline: a major road runs along one side of the lake, there are numerous cabins, one beaver lodge and dam at the outlet and a narrow bed of gravel beach; aquatic vegetation: some small patches of lily pads; lake substrate: fine silt and fine gravel close to shore, overlain with organic matter.

Nova Scotia Lake #55. (Jessie)
Map Coordinates: 44°02'(Lat.); 66°00'(Long.)
Terrestrial vegetation surroundng lake: mixed forest and shrubs right up to shore; shoreline: many camps, road along shore and a public landing, large expanses of fine gravel shoreline, some rocky stretches; aquatic vegetation: emergent grasses and lily pads; lake substrate: sand and gravel overlain with organic matter.

Nova Scotia Lake #56. (Tedford)
Map Coordinates: 44°06'(lat.); 66°01'(Long.)
Terrestrial vegetation surrounding the lake: mixed forest with shrubs close to shore; shoreline: some sand and gravel beaches, many camps, one access road; aquatic vegetation: some patches of lily pads and pickerel weed; lake substrate: sand and gravel.

Nova Scotia Lake #57. (Hart)
Map Coordinates: 45°38'(Lat.); 63°31'(Long.)
Accessibility: nearby road; 7/8 of lake perimeter treed; 5 m exposed shoreline between lake shore and treeline; rock shore along greater than 3/4 of shoreline; vegetation: mixed forest; lake features: cottages and boats; lake substrate: rocky as seen from gill net set; muddy from Eckman sample.

Nova Scotia Lake #58. (Long)
Map Coordinates: 45°40'(Lat.); 63°26'(Long.)
Accessibility: no access roads; 7/8 of lake perimeter treed; 3 m exposed shoreline between lake shore and treeline; 1/2 of shoreline was boggy areas; vegetation: mixed forest and bog plants; few emergent lily pads; no cottages; lake substrate: muddy as seen from gill net set; thick organic layer from Eckman sample.

Nova Scotia Lake #59. (Simpson)
Map Coordinates: 45°31'(Lat.); 63°56'(Long.)
Accessibility: nearby roads; 7/8 of shoreline treed; 2 m of shoreline from shore to treeline exposed; rock shore covered 3/4 of shoreline, grassy shore and gravel beach each covered less than 1/8 of shoreline; vegetation: mixed forest; few emergent reeds; lake features: cottages and a few islands; lake substrate: rock and gravel seen from gill net set; mud from Eckman sample.

Nova Scotia Lake #60. (Hattie)
New Coordinates: 45°17'(Lat.); 62°44'(Long.)
Accessibility: grown over logging road; 1/2 of shoreline treed; 0-5 m of shoreline from shore to treeline exposed; grassy shore covered 3/4 of shoreline; vegetation: mixed forest and grasses; a few dead spars; many lily pads covering about 1/2 of lake; lake features: evidence of some lumbering; lake substrate: rock seen from gill net set; thick organic layer and mud from Eckman sample.

Nova Scotia Lake #61. (Pictou)
Map Coordinates: 45°16'(Lat.); 62°45'(Long.)
Accessibility: old, apparently unused road; 7/8 of perimeter of shoreline treed; 1 m of shoreline exposed from shore to treeline; 1/2 of shoreline was grassy; vegetation: mixed forest; few dead spars; few lily pads, covered 1/8 of lake; lake features: no cottages, a few exposed rocks; lake substrate: rock and sand seen from gill net set; thick organic layer from Eckman sample.

Nova Scotia Lake #62. (Grand)
Map Coordinates: 44°54'(lat.); 63°09'(Long.)
Accessibility: nearby roads; 7/8 of perimeter of shoreline treed; 3/4 of shoreline rocky; vegetation: mixed forest with some open shore; few lily pads, covering 1/8 of lake; lake features: cottages; a few islands, and a few exposed rocks; lake substrate: rock seen from gill net set; thick organic layer from Eckman sample.

Nova Scotia Lake #63. (Alma)
Map Coordinates: 44°59'(Lat.); 62°46'(Long.)
Accessibility: no nearby roads, 7/8 of lake perimeter treed; 4 m of exposed shoreline from shore to treeline; 3/4 of shoreline covered with rock, less than 1/8 boggy areas; vegetation: mixed forest; lake features; few exposed rocks and many islands; lake substrate: rock seen from gill net set; thick organic layer for Eckman sample.

Nova Scotia Lake #64. (Robert)
Map Coordinates: 44°49'(Lat.); 63°21'(Long.)
Accessibility: no nearby roads, 5/8 of lake perimeter treed; 10 m of exposed shoreline from shore to treeline; 3/4 of shoreline covered with boulders and many rocky outcrops on shore; vegetation: mixed forest, and open shore with some grasses; lake features: few exposed rocks and a few islands; lake substrate: boulders seen from gill net set; thick organic layer from Eckman sample.

Nova Scotia Lake #65. (Hook)
Map Coordinates: 44°50'(Lat.); 62°57'(Long.)
Accessibility: no nearby roads; 7/8 of shoreline perimeter treed; 2 m of exposed shoreline from shore to treeline; 3/4 of shoreline covered with rock; vegetation: mixed forest; few lily pads, covering less than 1/8 of lake; lake features: few exposed rocks; lake substrate: detritus-covered bottom seen from gill net set; thick organic layer from Eckman sample.

Nova Scotia Lake #66. (Spuare)
New Coordinates: 45°00'(Lat.); 62°56'(Long.)
Accessibility: no nearby roads; 7/8 of shoreline perimeter treed; 1 m of exposed shoreline from shore to treeline; 3/4 of shoreline covered with rock; vegetation: mixed forest; a few pickerel weeds covering 1/8 of lake; lake features: a few exposed rocks and a few islands; lake substrate: detritus covering seen from gill net set; thick organic layer and vegetation from Eckman sample.

Nova Scotia Lake #67. (Unnamed)
Map Coordinates: 44°56'(Lat.); 62°42'(Long.)
Accessibility: no nearby roads; more than 7/8 of shoreline perimeter treed; 1 m exposed shoreline, exposed from shore to treeline; 3/4 of shoreline covered with rock; vegetation: mixed forest; few dead spars; few lily pads covering 1/8 of lake; lake features: few exposed rocks; lake substrate: detritus covering seen from gill net set; silt from Eckman sample.

Nova Scotia Lake #68. (Wilkins)
Map Coordinates: 45°20'(lat.); 61°04'(Long.)
Accessibility: major road along lake edge; 7/8 of shoreline perimeter treed; 0.5 m exposed shore from shore to treeline; less than 1/8 of shore covered with boulders; vegetation: coniferous forest and open shore; many dead spars; lake features: many cottages and a dam, few exposed rocks; lake substrate: boulders seen from gill net set; thick organic layer from Eckman sample.

Nova Scotia Lake #69. (Rocky)
Map Coordinates: 45°19'(Lat.); 61°17'(Long.)
Accessibility: no nearby roads, 1/2 of lake perimeter treed; 1 m of shoreline exposed from shore to treeline; 3/4 of shoreline covered with boulders; 1/4 grassy cover; vegetation: coniferous forest with many rocky outcrops; lake features: few exposed rocks; lake substrate: boulders seen from gill net set; mud from Eckman sample.

Nova Scotia Lake #70. (Mountain)
Map Coordinates: 45°15'(Lat.); 62°24'(Long.)
Accessibility: logging road approximately 200 yards from lake; all of lake perimeter treed; 0.5 m of shoreline exposed from shore to treeline; 3/4 of shoreline grassy; vegetation: mixed forest; many lily pads covering 3/8 of lake; lake features: few exposed rocks; lake substrate: boulders and gravel seen from gill net set; clay from Eckman sample.

Nova Scotia Lake #71. (French)
Map Coordinates: 46°31'(Lat.); 60°32'(Long.)
Accessibility: nearby road; 7/8 of lake perimeter treed; 1 m of shoreline exposed from shore to treeline; 1/4 of shoreline covered with gravel; 3/4 of shoreline covered with rock; vegetation: coniferous forest; lake features: cottages present and a few islands; lake substrate: rock seen from gill net set, mud and clay from Eckman sample.

Nova Scotia Lake #72. (LeBlanc)
New Coordinates: 46°37'(Lat.); 60°52'(Long.)
Accessibility: no nearby roads; 7/8 of lake perimeter treed; 2 m of shoreline exposed from shore to treeline; vegetation: coniferous forest; lake features: one island; lake substrate: boulders seen from gill net set.

Nova Scotia Lake #73. (Ingonish River)
Map Coordinates: 46°36'(Lat.); 60°36'(Long.)
Accessibility: no nearby roads; 1/2 of lake perimeter treed; 2 m of exposed shoreline from the shore to the treeline; grassy shore covering 1/4 of shore; vegetation: coniferous forest; few pickerel weeds; lake features: evidence of lumbering; lake substrate: gravel seen from gill net set; mud and clay from Eckman sample.

Nova Scotia Lake #74. (Trout)
Map Coordinates: 46°36'(Lat.); 60°51'(Long.)
Accessibility: no nearby road; 7/8 of lake perimeter treed; 1 m of shoreline exposed from the shore to the treeline; 1/4 of shoreline covered with grassy shore; vegetation: coniferous forest; few lily pads covering 1/8 of lake; lake features: one boat present and few islands; lake substrate:: detritus-covered rock seen from gill net set; mud and clay from Eckman sample.

Nova Scotia Lake #75. (MacEachern's)
Map Coordinates: 46°58'(Lat.); 60°33'(Long.)
Accessibility: no nearby roads, all of shoreline treed; 1 m of exposed shoreline from shore to treeline; shoreline is covered with grass; vegetation: mainly deciduous forest with some conifers; many dead spars, few lily pads; lake features: raft present; one island in lake; lake substrate: sand seen from gill net; mud from Eckman sample.

Nova Scotia Lake #76. (Red River)
Map Coordinates: 46°50'(Lat.); 60°39'(Long.)
Accessibility: no nearby road; 1/2 of shoreline perimeter treed; 2 m of exposed shoreline from shore to treeline; boggy areas covered 3/4 of shore; vegetation: coniferous forest; few dead spars; many pickerel weeds covering 1/4 of lake; lake substrate: boggy seen from gill net set; mud from Eckman sample.

Appendix 2. Major ion and DOC concentrations in samples from the various lakes surveyed. The figures in parentheses represent the calculated seasalt component, while the figures outside the parentheses are the concentrations "in excess" of seasalt contribution. All Cl^- considered derived from sea salt, although the concentrations have not been placed within parentheses.

Lake no.	Na^+	Mg^{2+}	Ca^{2+}	K^+	H^+	Cl^-	SO_4^{2-}	HCO_3^-	DOC
NB 1	17.5(112.9)	12.7(25.9)	52.4(5.0)	1.6(1.7)	5.6	132.8	86.7(13.3)	0	5.6
2	26.7(72.0)	24.6(16.5)	73.6(3.2)	3.0(1.1)	1.2	84.7	85.3(8.5)	24	7.6
3	18.4(76.8)	34.2(17.6)	95.9(3.4)	3.2(1.2)	0.9	90.4	84.8(9.0)	34	7.2
4	17.2(52.8)	10.9(12.1)	38.5(2.4)	4.8(0.8)	2.6	62.1	62.6(6.2)	2	3.2
5	18.9(52.8)	10.9(12.1)	42.0(2.4)	7.9(0.8)	3.0	62.1	56.3(6.2)	2	2.7
6	22.3(31.2)	16.6(7.2)	39.5(1.4)	7.2(0.5)	10.7	36.7	79.6(3.7)	0	4.3
7	23.8(43.2)	11.5(9.9)	35.5(1.9)	6.5(0.7)	8.2	50.8	57.4(5.1)	2	3.2
8	26.2(40.8)	12.8(9.4)	37.9(1.8)	6.8(0.6)	30.9	48.0	92.9(4.8)	0	6.4
9	26.8(38.4)	10.9(8.8)	39.7(1.7)	5.6(0.6)	5.6	45.2	85.1(4.5)	2	2.1
10	20.5(36.0)	8.1(8.3)	32.8(1.6)	4.8(0.6)	11.5	42.4	60.4(4.2)	0	2.1
11	17.9(50.4)	10.6(11.6)	41.7(2.2)	9.4(0.8)	9.3	59.3	83.7(5.9)	0	2.8
12	16.1(55.2)	7.0(12.7)	39.9(2.5)	6.4(0.8)	2.1	65.0	72.7(6.5)	4	2.7
13	28.1(48.0)	9.6(11.0)	37.3(2.1)	6.2(0.7)	12.0	56.5	77.6(5.7)	0	6.4
14	17.6(48.0)	8.7(11.0)	53.3(2.1)	7.5(0.7)	0.8	56.5	77.6(5.7)	20	2.8
15	0.7(48.0)	9.6(11.0)	27.3(2.1)	4.9(0.7)	11.5	56.5	77.6(5.7)	0	5.4
16	19.6(45.6)	13.3(10.5)	45.9(2.0)	7.2(0.7)	2.1	53.7	94.6(5.4)	6	2.4
17	20.9(40.8)	13.6(9.4)	44.6(1.8)	4.0(0.6)	1.7	48.0	89.0(4.8)	12	4.5
18	15.6(50.4)	9.0(11.6)	37.7(2.2)	13.6(0.8)	6.0	59.3	39.9(5.9)	2	5.6
19	1.8(64.8)	7.4(14.8)	43.5(2.9)	4.9(1.0)	1.4	76.2	77.8(7.6)	6	1.8
20	17.6(57.6)	16.4(13.2)	72.2(2.6)	6.8(0.9)	0.4	67.8	91.1(6.8)	24	3.3
21	9.8(48.0)	19.4(11.0)	46.8(2.1)	9.3(0.7)	2.3	56.5	94.3(5.7)	4	2.6
22	27.0(45.6)	31.4(10.5)	166.6(2.0)	8.0(0.7)	0	53.7	71.6(5.4)	160	3.0
23	13.1(50.4)	8.1(11.6)	47.7(2.2)	5.6(0.8)	1.2	59.3	77.4(5.9)	8	2.2
24	8.4(72.0)	12.3(16.5)	48.7(3.2)	5.6(1.1)	3.2	84.7	54.0(8.5)	2	2.1
25	15.9(62.4)	18.6(14.3)	76.0(2.8)	6.2(1.0)	0.3	73.4	90.6(7.3)	38	3.5
26	19.1(55.1)	26.8(12.7)	123.2(2.5)	7.4(0.8)	0.2	65.0	101.5(6.5)	78	4.6
27	19.1(60.0)	26.5(13.8)	95.1(2.7)	9.3(0.9)	0.2	70.6	90.8(7.1)	66	3.9
28	12.2(60.0)	33.9(13.8)	124.0(2.7)	6.0(0.9)	0.1	70.6	76.2(7.1)	98	4.5
29	25.9(57.6)	33.7(13.2)	174.5(2.6)	7.0(0.9)	0	67.8	70.2(6.8)	174	4.0
30	18.4(31.2)	15.8(7.2)	54.5(1.4)	4.6(0.5)	0.7	36.7	58.8(3.7)	20	5.9
31	10.5(31.2)	19.9(7.2)	72.0(1.4)	5.1(0.5)	0.2	36.7	58.8(3.7)	42	3.3
32	17.7(33.6)	29.3(7.7)	82.8(1.5)	5.9(0.5)	0.2	39.5	68.9(4.0)	60	5.1
33	25.2(14.4)	23.3(3.3)	74.2(0.6)	4.7(0.2)	0.2	16.9	62.8(1.7)	52	7.1
34	35.4(16.8)	22.3(3.9)	125.4(0.8)	7.5(0.2)	0.1	19.8	81.3(2.0)	98	7.4
35	23.4(9.6)	18.4(2.2)	60.5(0.4)	4.5(0.1)	0.2	11.3	67.7(1.1)	38	5.4
36	26.4(19.2)	38.4(4.4)	288.6(0.8)	3.5(0.3)	0	22.6	60.2(2.3)	242	11.2
37	33.6(16.8)	23.2(3.9)	96.0(0.8)	7.2(0.2)	0.2	19.8	66.8(2.0)	78	7.2
38	21.4(21.6)	25.4(5.0)	99.3(1.0)	6.4(0.3)	0.1	25.4	60.0(2.5)	74	8.6
39	21.0(21.6)	21.3(5.0)	73.8(1.0)	6.4(0.3)	0.6	25.4	76.7(2.5)	30	7.6
40	19.3(21.6)	29.5(5.0)	132.7(1.0)	5.9(0.3)	0.2	25.4	87.1(2.5)	74	11.9
41	17.5(31.2)	29.0(7.2)	108.4(1.4)	10.0(0.5)	0.1	36.7	67.1(3.7)	78	6.1
42	25.8(26.4)	26.0(6.0)	101.1(1.2)	11.1(0.4)	0.2	31.1	80.2(3.1)	70	6.0
43	23.8(19.2)	31.0(4.4)	125.4(0.8)	7.4(0.3)	0	22.6	81.0(2.3)	98	4.9
44	19.7(21.6)	36.1(5.0)	115.8(1.0)	8.7(0.3)	0.1	25.4	80.8(2.5)	78	6.5
45	21.9(21.6)	32.0(5.0)	119.2(1.0)	8.2(0.3)	0.1	25.4	91.3(2.5)	86	4.7
46	26.2(21.6)	40.2(5.0)	143.7(1.0)	9.4(0.3)	0	25.4	80.8(2.5)	126	6.5
47	18.8(26.4)	30.2(6.0)	179.9(1.2)	10.4(0.4)	0	31.1	80.2(3.1)	160	5.2
48	32.1(19.2)	40.8(4.4)	142.8(0.8)	8.9(0.3)	0	22.6	85.2(2.3)	124	5.5
49	23.6(26.4)	37.6(6.0)	150.0(1.2)	8.3(0.4)	0	31.1	55.2(3.1)	144	5.3

Lake no.	Na^+	Mg^{2+}	Ca^{2+}	K^+	H^+	Cl^-	SO_4^{2-}	HCO_3^-	DOC
50	35.5(28.8)	37.0(6.6)	159.9(1.3)	8.6(0.4)	0.6	33.9	94.5(3.4)	134	5.4
51	30.6(12.0)	26.9(2.7)	92.3(0.5)	7.5(0.2)	0.1	14.1	81.9(1.4)	70	3.6
52	38.2(19.2)	50.5(4.4)	174.7(0.8)	7.4(0.3)	0	22.6	72.7(2.3)	194	6.4
53	33.6(16.8)	23.2(3.9)	88.7(0.8)	9.3(0.2)	0.2	19.8	81.3(2.0)	52	8.3
54	26.9(9.6)	31.4(2.2)	85.4(0.4)	7.1(0.1)	0.1	11.3	60.3(2.2)	92	4.3
55	39.5(19.2)	31.6(4.4)	122.7(0.8)	13.0(0.3)	0	22.6	81.0(2.3)	120	6.9
56	19.9(38.4)	20.7(8.8)	68.3(1.7)	9.8(0.6)	0.8	45.2	91.3(4.5)	24	5.4
57	30.6(16.8)	56.9(3.9)	380.4(0.8)	7.2(0.2)	0	19.8	79.2(2.0)	430	8.5
58	51.9(16.8)	32.3(3.9)	149.4(0.8)	11.1(0.2)	0	19.8	79.2(2.0)	186	5.4
59	22.5(19.2)	24.4(4.4)	85.5(0.8)	5.3(0.3)	0.2	22.6	74.7(2.3)	80	7.1
60	-5.9(16.8)	107.9(3.9)	1047.1(0.8)	0.8(0.2)	4.3	19.8	133.4(2.0)	1076	15.0
61	29.3(7.2)	22.2(1.6)	74.5(0.3)	5.8(0.1)	1.1	8.5	78.3(0.9)	26	9.3
62	31.1(26.3)	31.8(6.0)	85.1(1.2)	8.3(0.4)	0.2	31.0	101.1(3.1)	84	6.8
63	32.1(9.6)	27.4(2.2)	78.9(0.4)	9.6(0.1)	0.2	11.3	88.5(1.1)	72	6.0
64	9.3(19.2)	13.6(4.4)	13.7(0.8)	2.3(0.3)	21.9	22.6	66.5(2.3)	0	9.3
65	17.2(57.6)	19.7(13.2)	106.7(2.6)	4.5(0.9)	0.2	67.8	118.2(6.8)	56	3.5
66	24.2(33.6)	18.6(7.7)	74.3(1.5)	4.4(0.5)	0.3	39.5	93.9(4.0)	52	3.4
67	27.5(40.8)	12.8(9.4)	32.6(1.8)	4.8(0.6)	1.7	48.0	95.2(4.8)	10	3.4
68	24.2(52.8)	37.2(12.1)	168.2(2.4)	7.4(0.8)	0	62.1	112.6(6.2)	150	3.7
69	16.4(38.4)	11.6(8.8)	53.2(1.7)	5.3(0.6)	1.1	45.2	91.3(4.5)	14	5.0
NS 1	7.0(165.2)	36.9(37.9)	59.9(7.4)	2.9(2.5)	0.2	194.3	76.4(19.4)	66	3.5
2	15.5(134.5)	27.6(30.8)	51.4(6.0)	5.7(2.0)	0.8	158.2	84.2(15.8)	30	5.9
3	8.5(117.6)	19.0(27.0)	39.2(5.2)	5.6(1.8)	2.9	138.4	65.4(13.8)	10	5.7
4	13.2(223.3)	26.1(51.2)	65.3(10.0)	16.3(3.4)	0.4	262.7	77.9(26.3)	58	5.3
5	5.4(117.6)	11.6(27.0)	28.7(5.2)	5.9(1.8)	5.1	138.4	57.0(13.8)	8	5.8
6	6.8(98.4)	71.1(22.6)	28.0(4.4)	4.9(1.5)	7.8	115.8	57.2(11.6)	0	11.5
7	0.5(105.6)	16.9(24.2)	42.2(4.7)	8.6(1.6)	4.4	124.3	73.0(12.4)	10	8.2
8	10.3(108.0)	12.2(24.8)	41.1(4.8)	4.8(1.6)	5.8	127.1	60.2(12.7)	8	10.4
9	19.3(112.9)	17.7(25.9)	38.9(5.0)	5.5(1.7)	2.1	132.8	70.0(13.3)	10	5.9
10	3.1(122.5)	8.9(28.1)	27.9(5.5)	5.3(1.9)	8.7	144.1	60.6(14.4)	0	4.9
11	14.6(117.6)	14.1(27.0)	32.2(5.2)	3.8(1.8)	15.8	138.4	63.2(13.8)	0	11.7
12	16.6(146.4)	11.6(33.6)	46.4(6.5)	12.9(2.2)	6.2	172.3	76.6(17.2)	12	16.3
13	16.3(108.0)	7.4(24.8)	23.1(4.8)	5.3(1.6)	19.5	127.1	70.6(12.7)	0	6.1
14	18.6(98.4)	7.0(22.6)	18.0(4.4)	4.4(1.5)	28.2	115.8	63.4(11.6)	0	8.2
15	11.1(91.2)	1.3(20.9)	6.8(4.1)	4.8(1.4)	14.5	107.3	52.3(10.2)	0	3.9
16	17.5(86.4)	2.4(19.8)	10.6(3.9)	5.6(1.3)	43.7	101.7	76.4(10.7)	0	11.5
17	12.4(84.1)	1.0(19.5)	6.6(3.8)	5.4(1.3)	40.8	98.9	52.5(10.0)	0	10.0
18	13.0(79.2)	0 (18.2)	4.4(3.5)	4.4(1.2)	20.9	93.2	53.2(9.3)	0	3.9
19	19.7(86.4)	4.0(19.8)	9.0(3.9)	5.1(1.3)	26.3	101.7	60.6(10.2)	0	6.7
20	17.5(91.2)	5.4(20.9)	9.8(4.1)	5.0(1.4)	28.8	107.3	51.8(10.7)	0	6.7
21	18.0(81.6)	5.1(18.7)	10.3(3.6)	5.5(1.2)	53.7	96.0	61.2(9.6)	0	11.6
22	16.6(100.8)	8.9(23.1)	24.4(4.5)	4.4(1.5)	4.4	118.6	69.3(11.9)	2	3.9
23	16.0(88.8)	26.2(20.4)	37.4(4.0)	5.3(1.4)	0.6	104.5	64.6(10.4)	28	3.6
24	9.9(98.4)	2.9(22.6)	10.1(4.4)	4.4(1.5)	17.8	115.8	59.2(11.6)	0	1.6
25	8.7(100.8)	1.6(23.1)	11.0(4.5)	4.7(1.5)	50.1	118.6	58.9(11.9)	0	14.3
26	21.0(91.2)	4.6(20.9)	8.4(4.1)	5.3(1.4)	31.6	107.3	74.7(10.7)	0	5.0
27	16.3(103.3)	1.8(23.7)	9.3(4.6)	5.6(1.6)	32.4	121.5	73.2(12.2)	0	5.4
28	16.4(88.8)	1.0(20.4)	8.0(4.0)	4.5(1.4)	58.9	104.5	64.6(10.4)	0	11.9
29	13.3(84.1)	0.2(19.5)	7.2(3.8)	4.1(1.3)	33.1	98.9	69.3(9.9)	0	6.4

Lake no.	Na^+	Mg^{2+}	Ca^{2+}	K^+	H^+	Cl^-	SO_4^{2-}	HCO_3^-	DOC
30	11.6(124.9)	5.9(28.6)	120.8(5.6)	4.8(1.9)	8.7	146.9	64.5(14.7)	0	4.1
31	12.1(129.6)	3.1(29.7)	17.6(5.8)	3.6(2.0)	8.7	152.5	74.4(15.2)	0	3.2
32	9.0(180.1)	10.5(41.3)	25.4(8.0)	2.3(2.8)	21.4	211.9	70.5(21.2)	0	7.1
33	10.8(141.7)	10.3(32.5)	30.1(6.3)	3.7(2.2)	5.9	166.7	72.9(16.7)	2	5.5
34	13.8(148.8)	13.6(34.1)	31.3(6.6)	4.6(2.3)	3.0	175.1	61.7(17.5)	16	6.3
35	14.4(91.2)	5.4(20.9)	14.4(4.1)	3.7(1.4)	33.1	107.3	60.1(10.7)	0	9.2
36	19.2(96.0)	3.5(22.0)	19.6(4.3)	4.4(1.5)	22.4	113.0	69.9(11.3)	0	6.5
37	20.4(69.6)	13.6(16.0)	27.8(3.1)	3.3(1.1)	17.0	81.9	81.4(8.2)	0	8.8
38	10.6(81.6)	23.2(18.7)	58.8(3.6)	7.5(1.2)	0.6	96.0	65.4(9.6)	40	4.7
39	12.3(41.2)	15.3(20.9)	58.3(4.1)	5.5(1.4)	0.4	107.3	64.3(10.7)	40	4.5
40	23.2(86.4)	18.0(19.8)	49.5(3.9)	4.6(1.3)	1.1	101.7	58.6(10.2)	30	6.1
41	13.5(100.8)	17.1(23.1)	44.9(4.5)	4.9(1.5)	1.2	118.6	77.7(11.9)	16	4.5
42	12.3(81.6)	10.1(18.7)	19.4(3.6)	4.4(1.2)	22.4	96.0	59.2(9.6)	0	10.9
43	21.1(74.5)	15.0(17.1)	38.1(3.3)	3.8(1.1)	1.7	87.6	72.4(8.8)	10	4.0
44	10.6(76.8)	7.1(17.6)	15.6(3.4)	3.7(1.2)	18.6	90.4	66.0(9.0)	0	5.1
45	4.3(129.6)	5.7(29.7)	21.4(5.8)	4.0(1.9)	13.5	152.5	70.2(15.2)	0	4.0
46	8.2(196.9)	0 (45.2)	60.6(8.8)	4.4(3.0)	0.6	231.6	37.2(23.2)	24	4.5
47	14.0(96.0)	10.9(22.0)	38.6(4.3)	3.9(1.5)	10.0	113.0	69.9(11.3)	0	6.0
48	12.8(72.0)	26.3(16.5)	63.7(3.2)	5.3(1.1)	0.4	84.7	72.7(8.5)	42	5.5
49	37.0(60.0)	22.4(13.8)	42.7(2.7)	7.0(0.9)	0.6	70.6	88.7(7.1)	32	6.4
50	11.7(64.8)	9.8(14.8)	25.5(2.9)	3.6(1.0)	5.9	76.2	52.8(7.6)	6	13.8
51	23.8(79.2)	16.3(18.2)	37.9(3.5)	5.7(1.2)	1.3	93.2	80.3(9.3)	18	5.4
52	13.2(72.0)	16.4(16.5)	42.7(3.2)	4.8(1.1)	1.0	84.7	60.3(8.5)	22	8.5
53	22.2(60.0)	12.5(13.8)	17.3(2.7)	2.4(0.9)	5.3	70.6	53.1(7.1)	2	6.1
54	11.5(187.2)	12.9(43.0)	25.5(8.4)	4.0(2.9)	31.6	220.3	77.4(28.8)	0	13.2
55	3.6(244.9)	29.3(56.2)	58.0(10.9)	7.8(3.7)	0.8	288.1	73.8(22.0)	22	5.0
56	2.0(228.1)	28.2(52.3)	70.1(10.2)	9.1(3.5)	0.4	268.4	79.4(26.8)	38	2.9
57	6.3(72.8)	15.4(16.7)	43.2(3.2)	3.0(1.1)	1.0	85.7	62.2(8.6)	18	3.0
58	23.9(51.0)	20.4(11.7)	104.0(2.3)	2.3(0.8)	0.2	60.0	73.2(6.0)	72	5.9
59	6.8(55.8)	16.8(12.8)	50.4(2.5)	4.3(0.8)	0.3	65.7	62.2(6.6)	32	3.9
60	7.3(99.5)	15.8(22.8)	43.0(4.4)	1.1(1.5)	35.5	117.1	77.9(11.7)	0	13.9
61	8.4(77.7)	11.8(17.8)	33.3(3.5)	3.9(1.2)	3.7	91.4	70.1(9.1)	4	3.9
62	6.3(102.0)	15.2(23.4)	45.4(4.5)	5.8(1.6)	1.4	120.0	69.2(12.0)	14	4.6
63	6.2(94.7)	7.0(21.7)	23.7(4.2)	4.2(1.4)	5.8	111.4	70.8(11.1)	0	3.0
64	5.3(82.5)	2.5(18.9)	12.8(3.7)	3.8(1.3)	42.7	97.1	75.7(9.7)	0	7.3
65	13.1(136.0)	11.6(31.2)	54.7(6.1)	5.3(2.1)	3.2	160.0	81.9(16.0)	16	7.3
66	9.4(72.8)	8.8(16.7)	33.2(3.2)	1.5(1.1)	6.9	85.7	62.2(8.6)	0	4.3
67	9.2(94.7)	4.6(21.7)	13.8(4.2)	2.4(1.4)	9.8	111.4	45.1(11.1)	0	3.3
68	2.5(262.3)	4.8(60.2)	24.7(11.7)	6.0(4.0)	3.0	308.6	75.3(30.9)	4	2.8
69	19.9(104.4)	7.3(23.9)	5.8(4.7)	2.0(1.6)	55.0	122.8	91.9(12.3)	0	19.0
70	10.2(72.8)	9.6(16.7)	20.2(3.2)	3.5(1.1)	7.9	85.7	64.3(8.6)	0	4.5
71	2.2(99.5)	10.9(22.8)	49.5(4.4)	10.5(1.5)	0.5	117.1	44.5(11.7)	30	5.5
72	18.4(131.2)	20.1(30.1)	53.0(5.9)	8.0(2.0)	0.6	154.3	53.4(15.4)	38	11.6
73	8.2(104.4)	19.7(23.9)	39.7(4.7)	9.2(1.6)	0.5	122.8	43.9(12.3)	32	6.6
74	0.8(133.5)	11.3(30.6)	43.9(6.0)	8.2(2.0)	0.5	157.1	46.8(15.7)	30	4.6
75	13.8(227.9)	41.4(52.4)	354.0(10.2)	6.7(3.5)	0	268.6	60.6(26.9)	370	5.6
76	35.2(170.0)	39.1(39.0)	276.8(7.6)	5.9(2.0)	0	200.0	63.3(20.0)	296	13.1

N.B. X = +2.6
N.S. X = -2.0

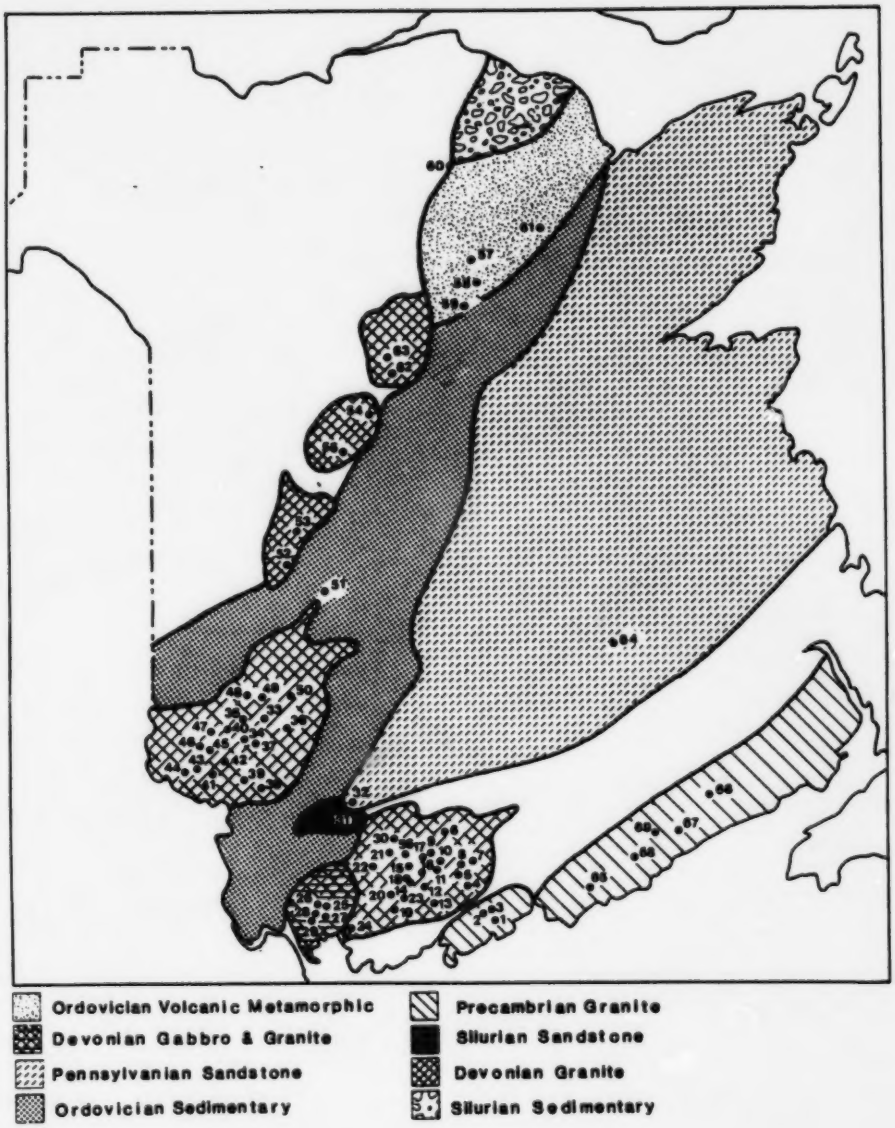

Fig. 1. Geographical location of lakes sampled in New Brunswick as related to bedrock geology (derived from Potter et al. 1979).

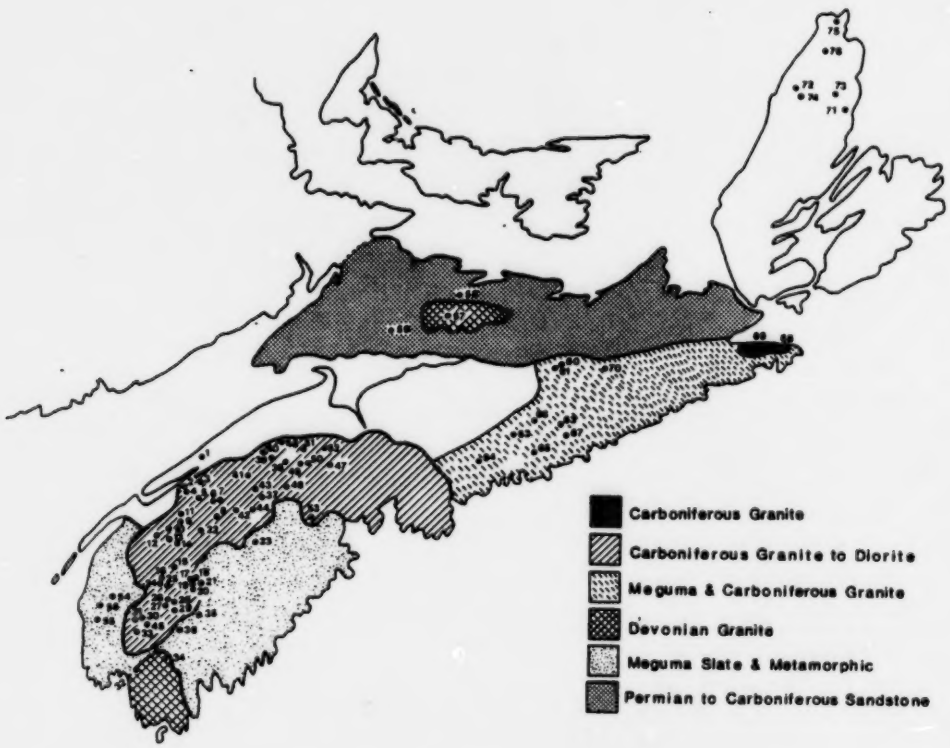

Fig. 2. Geographical location of lakes sampled in Nova Scotia and related to bedrock geology (derived from Keppie 1979).

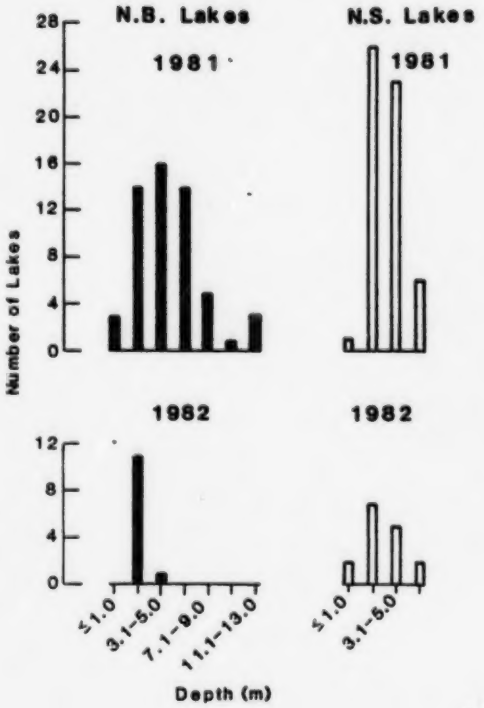

Fig. 3. Frequency distributions of sampled lake depths by province and year.

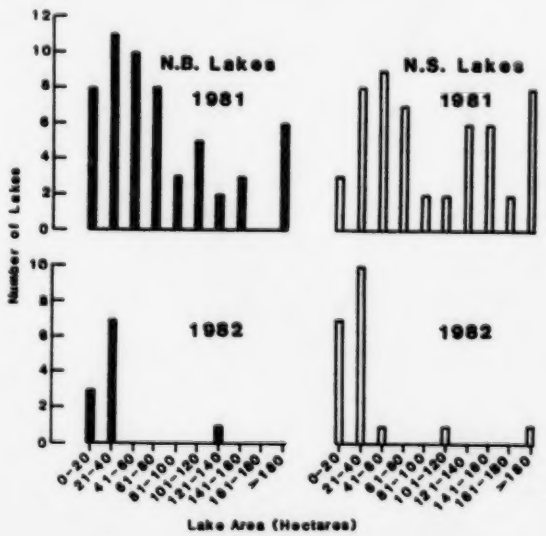

Fig. 4. Frequency distributions of sampled lake areas by province and year.

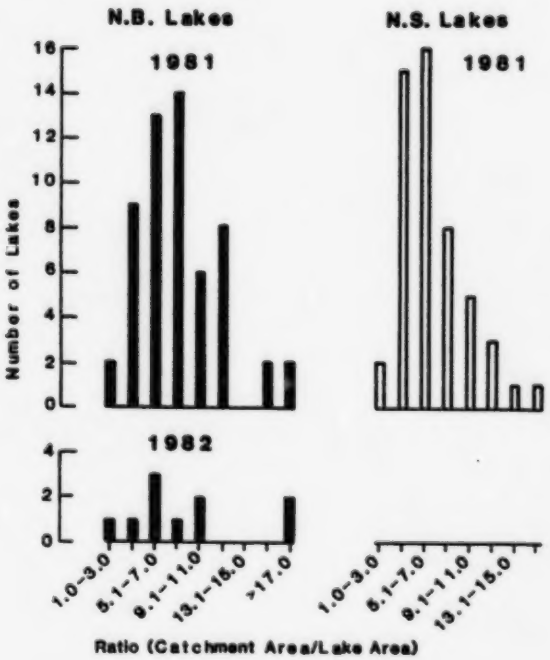

Fig. 5. Frequency distributions of catchment area:lake area for lakes sampled, by province and year.

Fig. 6. Chloride isopleths (determined by eye) for lakes surveyed in N.B. and N.S. (based on 145 data points).

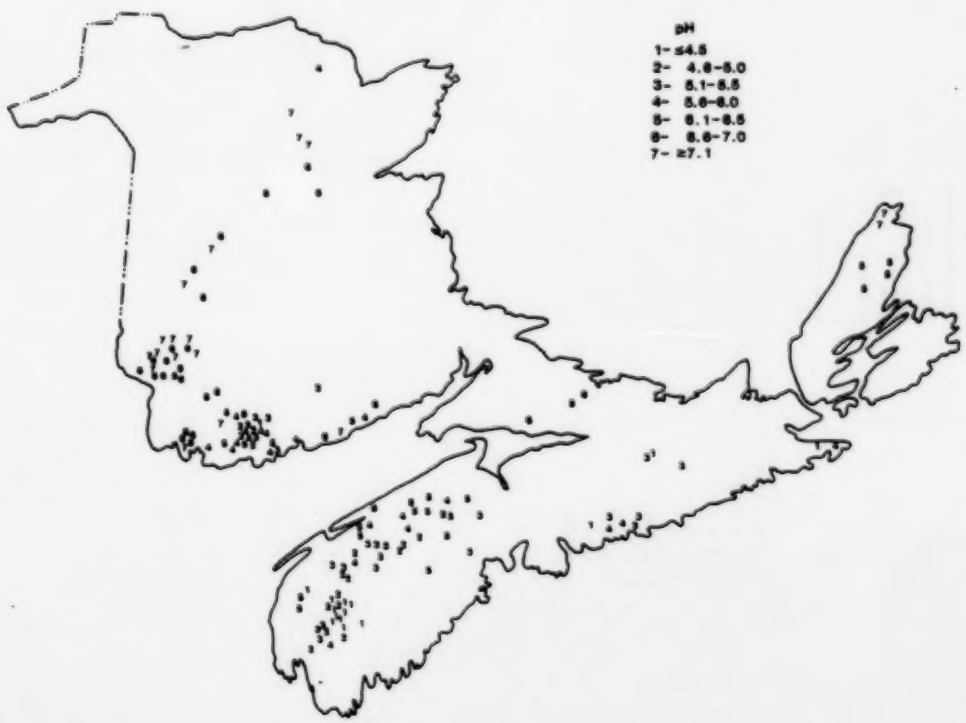

Fig. 7. Geographic distribution of water pH levels measured on the surveyed lakes.

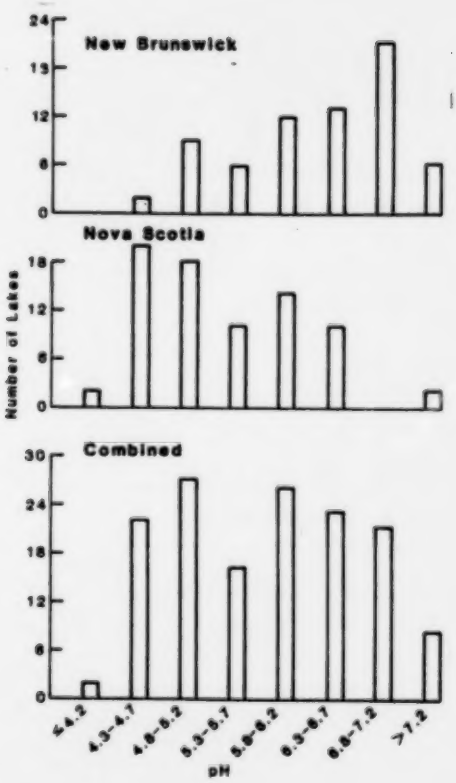

Fig. 8. Frequency distributions of lake pH for New Brunswick and Nova Scotia lakes.

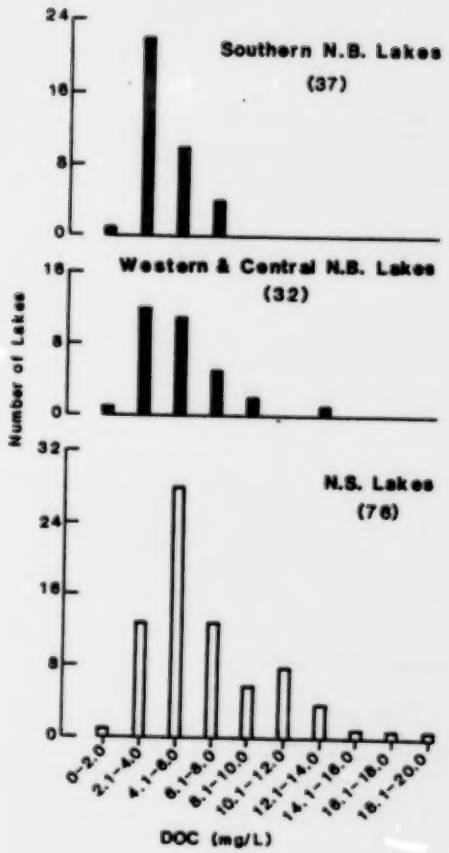

Fig. 9. Frequency distributions of the total organic carbon content of sample lakes for the regions indicated for each panel. Numbers in parentheses indicate the number of lakes represented by each distribution.

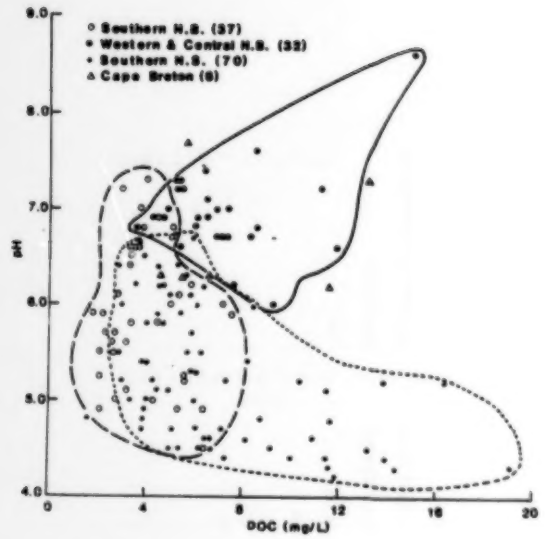

Fig. 10. The pH-DOC characteristics of all lakes surveyed. The solid line encompasses lakes sampled in western and central N.B., the dashed line encompasses all lakes sampled in southern N.B., and the finely dashed line encompasses all lakes sampled in southern N.S.

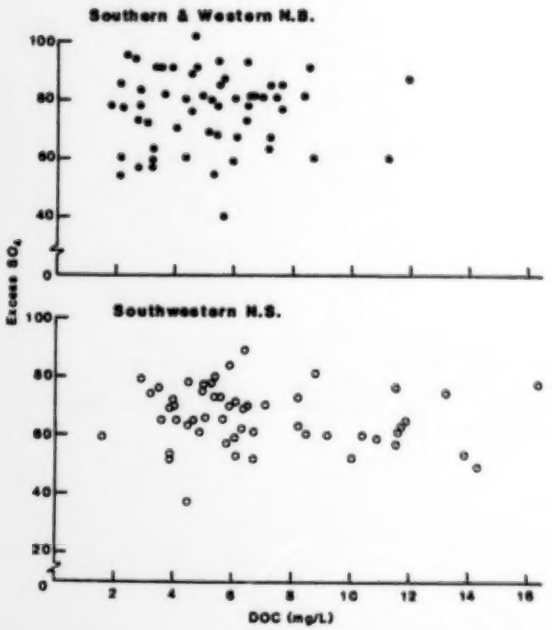

Fig. 11. Scattergrams of lake excess sulfate (sea salt component subtracted) expressed as a function of DOC for two groups of lakes which should receive relatively uniform atmospheric leadings of SO_4^{2-}. Note the presence of an asterisk in the text denotes levels in "excess" of the sea salt components.

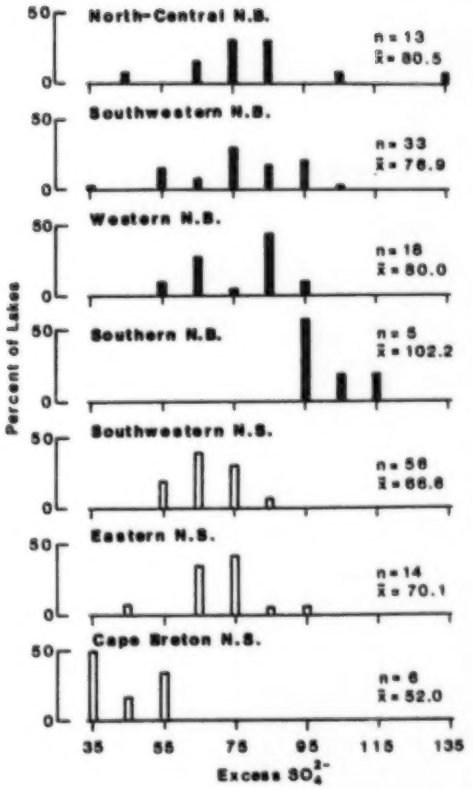

Fig. 12. Frequency distribution of excess sulfate concentrations in lakes from various regions of N.B. and N.S. n = number of lakes for each panel, $\bar{x}$ is the mean sulfate concentration for each lake group.

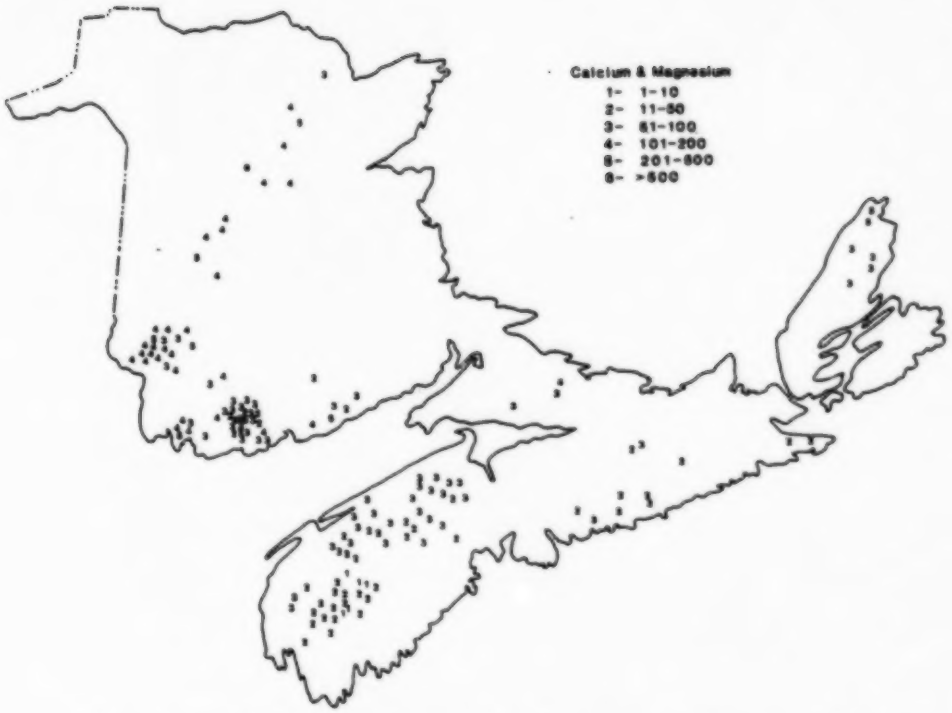

Fig. 13. Excess calcium plus magnesium concentrations are illustrated on an arbitrary scale of 1 to 6 in order of increasing concentration. Concentration ranges (μeq/L) for each category in the scale is shown upper right.

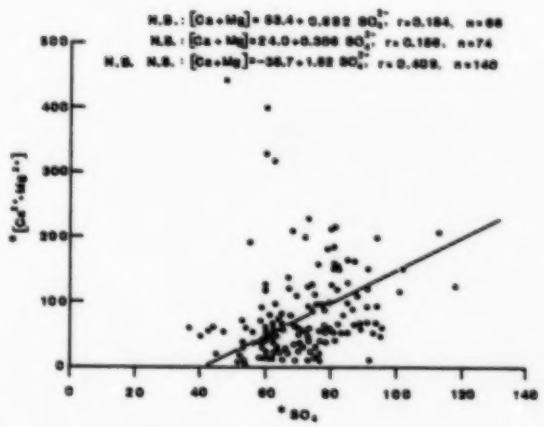

Fig. 14. A scatter diagram of excess lake Ca^{2+} + Mg^{2+} as a function of excess lake SO_4^{2-}. The drawn line is that for N.B. and N.S. data combined. The improved correlation for the data sets from the two provinces combined is considered coincidental owing to the fact that N.B. lakes are, in general, better buffered and receive higher atmospheric loadings. Five lakes are omitted (northern N.B. and Cape Breton) that had very high *[Ca^{2+} + Mg^{2+}].

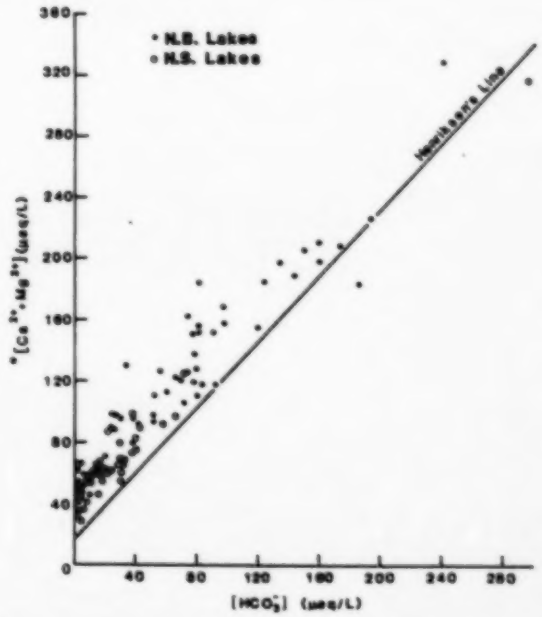

Fig. 15. The relationship of excess Ca^{2+} for N.B. and N.S. lakes to Henriksen's empirical line (Alk = -14 + 0.93 *[Ca^{2+} + Mg^{2+}]. The fact that most points lie above the line implies some loss of alkalinity.

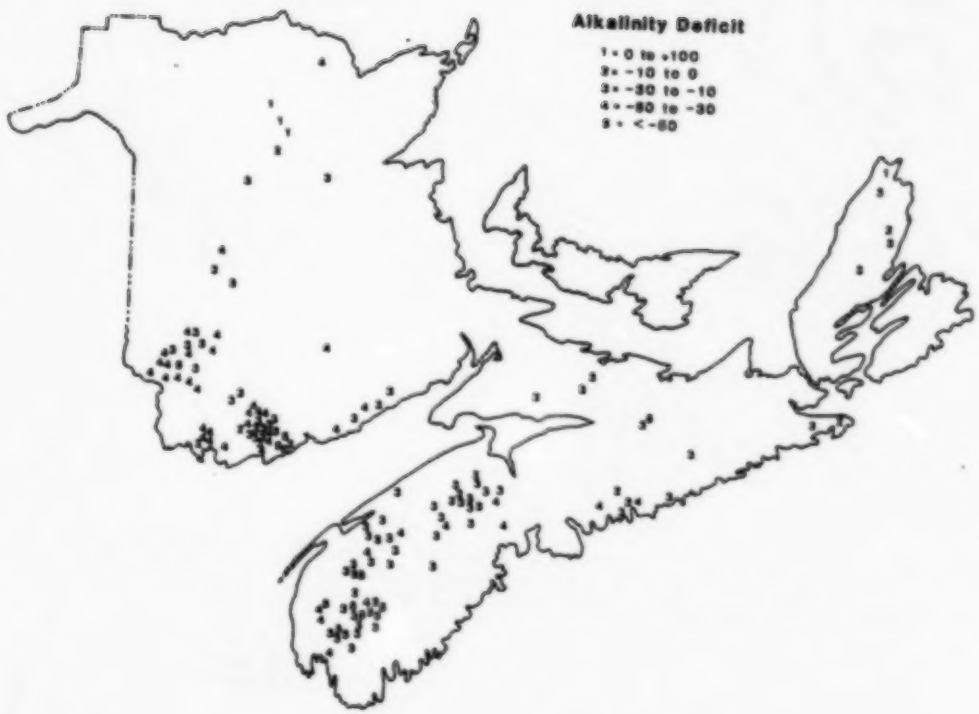

Fig. 16. Alkalinity "deficits" (defined as the horizontal distance separating points from the theoretical line in Fig. 15) are mapped for lakes sampled in N.B. and N.S. More negative "deficits" imply greater loss of buffering capacity.

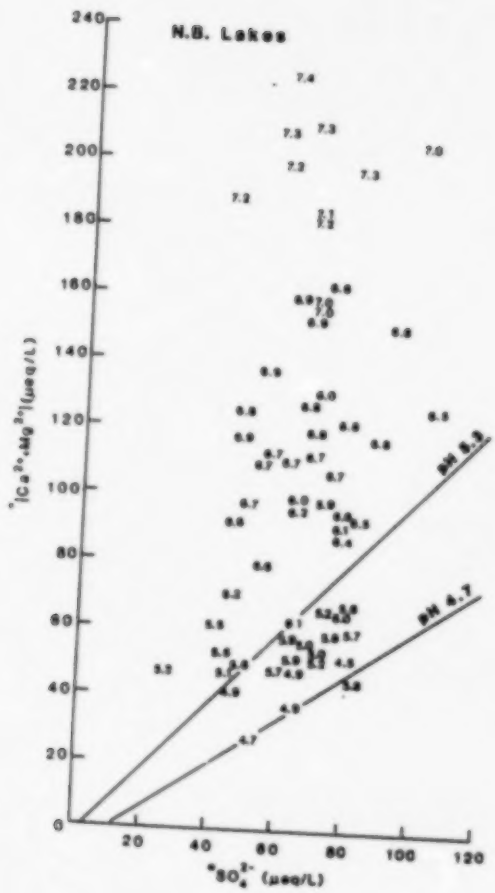

Fig. 17. Data for N.B. lakes are arrayed on a Henriksen nomograph relating $*[Ca^{2+} + Mg^{2+}]$ to $*SO_4^{2-}$. The lines are empirical, derived from data obtained from Norwegian lakes. The nomograph represents an attempt to relate pH to both buffer capacity and acid loading.

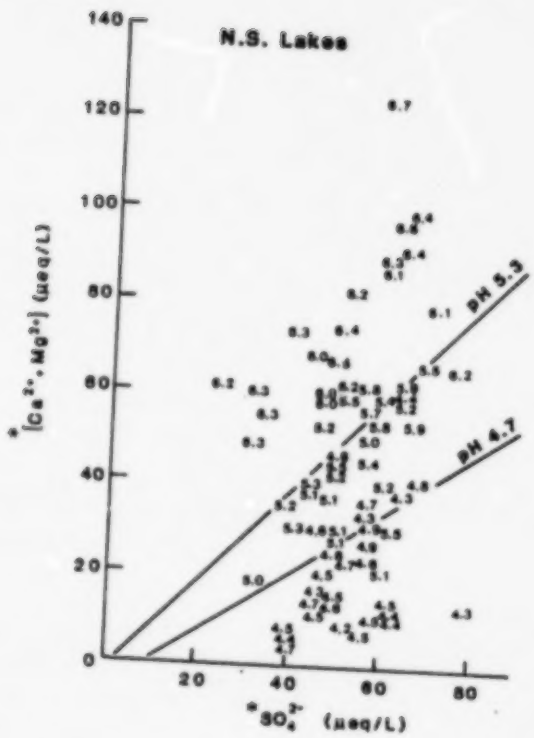

Fig. 18. Data for N.S. lakes are arrayed on the Henriksen nomograph. For more detail, see legend for Fig. 17.

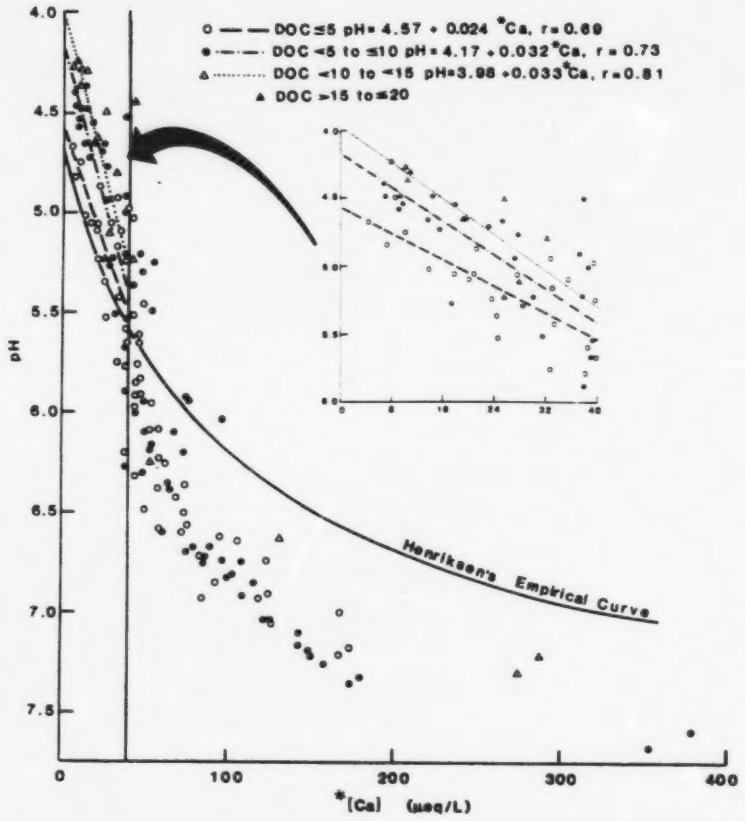

Fig. 19. The influence of total organic carbon on the $*Ca^{2+}$-pH relationships for N.B. and N.S. lakes (combined) is illustrated. DOC increases the acidity at pH levels less than 5.5 (corresponding to a $*Ca^{2+}$ of about 40 μeq/L. The points do not follow Henriksen's curve particularly well.

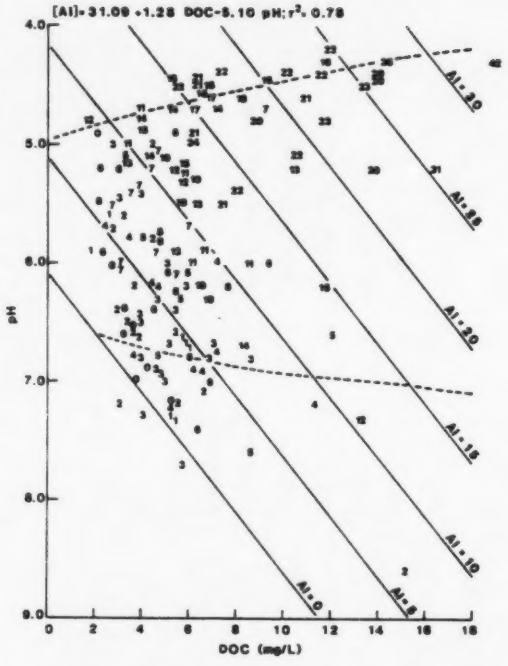

Fig. 20. Total aluminum concentrations (μeq/L) in lake water are arrayed in relation to lake pH and DOC. It was assumed that Al had a valence of +3. The solid lines are isopleths of Al concentration, derived from a step-wise multiple regression of [Al] on lake pH and DOC. The equation of the surface from which the isopleths were derived is expressed at the top of the figure. It was found that higher powers of the two independent variables and interactive terms did not improve the fit significantly. The dotted lines are derived from the pH solubility curve of Al by fitting them to the proper location on a given isopleth for the corresponding pH.

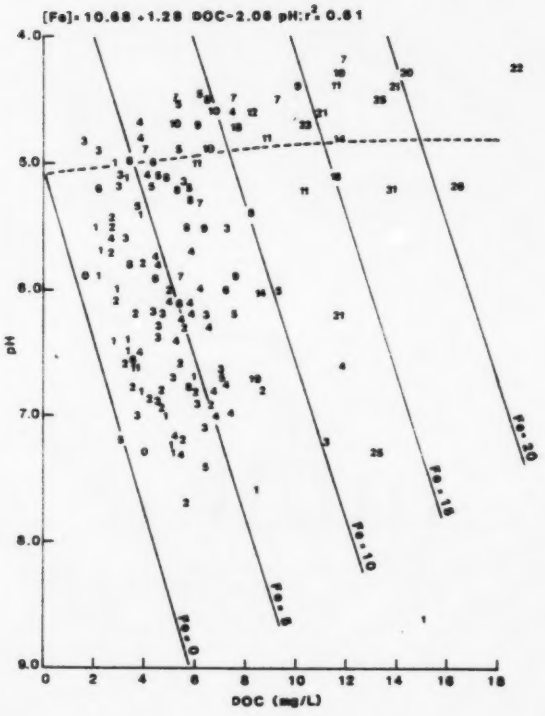

Fig. 21. Total dissolved iron concentrations in lake water samples are arrayed in relation to pH and DOC. The equation of the surface from which the isopleths (solid lines) are derived is given at the top of the figure. The dotted line is fitted from the pH solubility curve for Fe (valence assumed to be +3) as described for Al in Fig. 20.

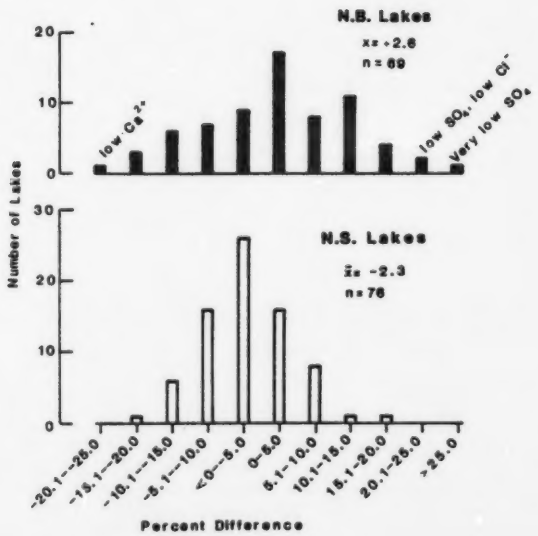

Fig. 22. The frequency distribution of percent differences between summed cations and summed anions (on a net charge basis) is shown for samples from N.B. lakes (upper) and N.S. lakes (lower). Organic anions, Al and Fe, were ignored in constructing the charge balance. Possible explanations for some of the greater percentage differences for N.B. samples are given on the figure.

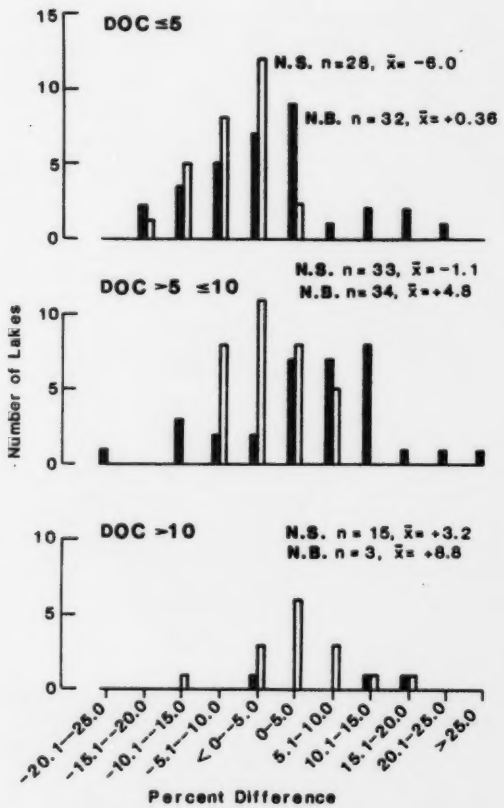

Fig. 23. The influence of DOC on the frequency distribution of charge balance for samples from N.B. (solid bars) and N.S. (open bars) is shown. The percent difference has an increasingly positive bias as DOC is increased.